

Report No. FAA-CT-81-40

LEVEL II

12

**A COMPENDIUM OF
AIRCRAFT COCKPIT VISION SURVEYS
1950 THROUGH 1980 - VOLUME I**

Anthony J. Barile



**DTIC
ELECTE
JUL 17 1981**

S D F

FINAL REPORT

MAY 1981

Document is available to the U.S. public through
the National Technical Information Service,
Springfield, Virginia 22161

Prepared for

**U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
TECHNICAL CENTER
Atlantic City Airport, N.J. 08406**

81 7 16 056

AD A101473

DTIC FILE COPY

Technical Report Documentation Page

1. Report No. 14 FAA-CF-81-40-VOL-2		2. Government Accession No. AD-A202473		3. Recipient's Catalog No.	
4. Title and Subtitle 6 A COMPENDIUM OF AIRCRAFT COCKPIT VISION SURVEYS, 1959 THROUGH 1980, VOLUME 1.		5. Report Date 11 May 1981		6. Performing Organization Code	
7. Author(s) 10 A. J. Barile (Anthony)		8. Performing Organization Report No. ACT-340		9. Performing Organization Name and Address Federal Aviation Administration Technical Center Atlantic City Airport, New Jersey 08405	
10. Work Unit No. (TRAIS)		11. Contract or Grant No. 184-340-400		12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Aviation Administration Technical Center Atlantic City Airport, New Jersey 08405 (12) 249/	
13. Type of Report and Period Covered 9 Final Rept. 1959-1980		14. Sponsoring Agency Code		15. Supplementary Notes	
16. Abstract This publication contains a history of cockpit visibility surveys which were conducted to measure and record aircraft (General Aviation, Transport, Helicopter, Military) cockpit visibility. Many of the aircraft were involved in midair collisions, accident investigations, research and development, and the design up through production implementation. The Federal Aviation Administration (FAA) Binocular Camera is a standard means to accurately measure cockpit visibility, which in the certification process for civil aircraft is an invaluable tool for industry and the FAA. Therefore, the information contained in this document is intended to contribute to aviation safety.					
17. Key Words Cockpit Visibility Binocular Camera Midair Collisions Aviation Safety Accident Investigations Surveys Research and Development Certification Process			18. Distribution Statement Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages	
				22. Price	

TABLE OF CONTENTS

	Page
INTRODUCTION	1
DISCUSSION	1
Equipment Description	2
Survey Procedure	3
Binocular Vision	3
Authors Comment	4
REFERENCES	4

Accession For		
NTIS GRA&I <input checked="" type="checkbox"/>		
DTIC TAB <input type="checkbox"/>		
Unannounced <input type="checkbox"/>		
Justification		
By _____		
Distribution/ _____		
Availability Codes		
Dist	Avail and/or	
	Special	
A		

LIST OF ILLUSTRATIONS

Figure		Page
1	FAA Technical Center Binocular Camera	5
2	Section Through Camera Showing Optical Arrangement	6
3	CL-600 Cockpit With Binocular Camera	7
4	CL-600 Left Side View	8
5	Pilots Eye Position	9
6	Normal Design Eye Reference Point	10
7	Alert Design Eye Reference Point	10
8	Binocular Vision	11
9	Binocular Cockpit Visibility Photograph of Aircraft Aero Commander 1121	13
10	Binocular Cockpit Visibility Photograph of Aircraft Boeing 707	14
11	Binocular Cockpit Visibility Photograph of Aircraft Boeing 727	15
12	Binocular Cockpit Visibility Photograph of Aircraft Boeing 727-200	16
13	Binocular Cockpit Visibility Photograph of Aircraft Boeing 747	17
14	Binocular Cockpit Visibility Photograph of Aircraft Canadair, LTD., CL-44	18
15	Binocular Cockpit Visibility Photograph of Aircraft Canadair Challenger CL-600	19
16	Binocular Cockpit Visibility Photograph of Aircraft Cessna 620	20
17	Binocular Cockpit Visibility Photograph of Aircraft Cessna Citation III	21
18	Binocular Cockpit Visibility Photograph of Aircraft Convair 240	22
19	Binocular Cockpit Visibility Photograph of Aircraft Convair 340	23

LIST OF ILLUSTRATIONS (Continued)

Figure		Page
20	Binocular Cockpit Visibility Photograph of Aircraft Convair 580	24
21	Binocular Cockpit Visibility Photograph of Aircraft Convair 880	25
22	Binocular Cockpit Visibility Photograph of Aircraft Curtiss-Wright 200	26
23	Binocular Cockpit Visibility Photograph of Aircraft Douglas DC-3	27
24	Binocular Cockpit Visibility Photograph of Aircraft Douglas DC-4	28
25	Binocular Cockpit Visibility Photograph of Aircraft Douglas DC-6	29
26	Binocular Cockpit Visibility Photograph of Aircraft Douglas DC-7	30
27	Binocular Cockpit Visibility Photograph of Aircraft Douglas DC-8	31
28	Binocular Cockpit Visibility Photograph of Aircraft Douglas DC-9	32
29	Binocular Cockpit Visibility Photograph of Aircraft Douglas DC-9-50	33
30	Binocular Cockpit Visibility Photograph of Aircraft Douglas DC-9-80	34
31	Binocular Cockpit Visibility Photograph of Aircraft Fairchild F-27	35
32	Binocular Cockpit Visibility Photograph of Aircraft Fairchild FH-227	36
33	Binocular Cockpit Visibility Photograph of Aircraft Falcon Fan Jet 20	37
34	Binocular Cockpit Visibility Photograph of Aircraft Lear Jet Model 24	38
35	Binocular Cockpit Visibility Photograph of Aircraft Gates Lear Jet Model 35/36	39

LIST OF ILLUSTRATIONS (Continued)

Figure		Page
36	Binocular Cockpit Visibility Photograph of Aircraft Gates Lear Jet Model 55	40
37	Binocular Cockpit Visibility Photograph of Aircraft Grumman Gulfstream	41
38	Binocular Cockpit Visibility Photograph of Aircraft Howard Model 500	42
39	Binocular Cockpit Visibility Photograph of Aircraft Lockheed Electra	43
40	Binocular Cockpit Visibility Photograph of Aircraft Lockheed 1329	44
41	Binocular Cockpit Visibility Photograph of Aircraft Lockheed Model 300	45
42	Binocular Cockpit Visibility Photograph of Aircraft Lockheed L-1049A	46
43	Binocular Cockpit Visibility Photograph of Aircraft Martin Model 404	47
44	Binocular Cockpit Visibility Photograph of Aircraft Mitsubishi MU-300	48
45	Binocular Cockpit Visibility Photograph of Aircraft NASA/Boeing-737	49
46	Binocular Cockpit Visibility Photograph of Aircraft Sunrise S-1600	50
47	Binocular Cockpit Visibility Photograph of Aircraft Super G Constellation	51
48	Binocular Cockpit Visibility Photograph of Aircraft Vickers Viscount	52
49	Binocular Cockpit Visibility Photograph of Aircraft Aero Commander 680E	54
50	Binocular Cockpit Visibility Photograph of Aircraft Beechcraft Baron B-55	55
51	Binocular Cockpit Visibility Photograph of Aircraft Beechcraft Model 99	56

LIST OF ILLUSTRATIONS (Continued)

Figure		Page
52	Binocular Cockpit Visibility Photograph of Aircraft Cessna 140A	57
53	Binocular Cockpit Visibility Photograph of Aircraft Cessna 150F	58
54	Binocular Cockpit Visibility Photograph of Aircraft Cessna 170	59
55	Binocular Cockpit Visibility Photograph of Aircraft Cessna 172	60
56	Binocular Cockpit Visibility Photograph of Aircraft Cessna 177	61
57	Binocular Cockpit Visibility Photograph of Aircraft Cessna 180	62
58	Binocular Cockpit Visibility Photograph of Aircraft Cessna 182	63
59	Binocular Cockpit Visibility Photograph of Aircraft Cessna Skywagon	64
60	Binocular Cockpit Visibility Photograph of Aircraft Cessna 210	65
61	Binocular Cockpit Visibility Photograph of Aircraft Cessna 310	66
62	Binocular Cockpit Visibility Photograph of Aircraft Cessna 337B	67
63	Binocular Cockpit Visibility Photograph of Aircraft DeHavilland DHC-6	68
64	Binocular Cockpit Visibility Photograph of Aircraft Helio-Plane	69
65	Binocular Cockpit Visibility Photograph of Aircraft Helio Model 500	70
66	Binocular Cockpit Visibility Photograph of Aircraft Mooney 21	71
67	Binocular Cockpit Visibility Photograph of Aircraft Piper Arrow PA-28R-200	72

LIST OF ILLUSTRATIONS (Continued)

Figure		Page
68	Binocular Cockpit Visibility Photograph of Aircraft Piper Aztec PA-23	73
69	Binocular Cockpit Visibility Photograph of Aircraft Piper Cherokee Archer PA-28-181	74
70	Binocular Cockpit Visibility Photograph of Aircraft Piper Cherokee Archer PA-28-140B	75
71	Binocular Cockpit Visibility Photograph of Aircraft Piper Cherokee PA-28-180	76
72	Binocular Cockpit Visibility Photograph of Aircraft Piper Cherokee 6 PA-32-260	77
73	Binocular Cockpit Visibility Photograph of Aircraft Piper Navajo PA-31	78
74	Binocular Cockpit Visibility Photograph of Aircraft Swift 125	79
75	Binocular Cockpit Visibility Photograph of Aircraft Air Force B-52A	81
76	Binocular Cockpit Visibility Photograph of Aircraft Air Force B-52G	82
77	Binocular Cockpit Visibility Photograph of Aircraft Air Force B-57E	83
78	Binocular Cockpit Visibility Photograph of Aircraft Air Force C-124	84
79	Binocular Cockpit Visibility Photograph of Aircraft Lockheed C-130B	85
80	Binocular Cockpit Visibility Photograph of Aircraft Air Force C-133	86
81	Binocular Cockpit Visibility Photograph of Aircraft Air Force C-141	87
82	Binocular Cockpit Visibility Photograph of Aircraft DeHavilland CV-7A	88
83	Binocular Cockpit Visibility Photograph of Aircraft Air Force F-4E	89

LIST OF ILLUSTRATIONS (Continued)

Figure		Page
84	Binocular Cockpit Visibility Photograph of Aircraft Air Force F-89	90
85	Binocular Cockpit Visibility Photograph of Aircraft Air Force F-100A	91
86	Binocular Cockpit Visibility Photograph of Aircraft Air Force F-101	92
87	Binocular Cockpit Visibility Photograph of Aircraft Air Force F-102A	93
88	Binocular Cockpit Visibility Photograph of Aircraft Air Force F-104A	94
89	Binocular Cockpit Visibility Photograph of Aircraft Air force F-106A	95
90	Binocular Cockpit Visibility Photograph of Aircraft Air Force F-111D	96
91	Binocular Cockpit Visibility Photograph of Aircraft Air Force F/B-111	97
92	Binocular Cockpit Visibility Photograph of Aircraft Air Force KC-135	98
93	Binocular Cockpit Visibility Photograph of Aircraft Army L-19	99
94	Binocular Cockpit Visibility Photograph of Aircraft Army L-20A	100
95	Binocular Cockpit Visibility Photograph of Aircraft Army L-2	101
96	Binocular Cockpit Visibility Photograph of Aircraft Army LC-126	102
97	Binocular Cockpit Visibility Photograph of Aircraft Martin P5M-1	103
98	Binocular Cockpit Visibility Photograph of Aircraft Martin XP-6M-1	104
99	Binocular Cockpit Visibility Photograph of Aircraft Navy F-4D	105

LIST OF ILLUSTRATIONS (Continued)

Figure		Page
100	Binocular Cockpit Visibility Photograph of Aircraft Navy P2V-5F	106
101	Binocular Cockpit Visibility Photograph of Aircraft Navy R5D-2Z	107
102	Binocular Cockpit Visibility Photograph of Aircraft Navy SNB-5	108
103	Binocular Cockpit Visibility Photograph of Aircraft Navy OE-2	109
104	Binocular Cockpit Visibility Photograph of Aircraft Air Force T-33	110
105	Binocular Cockpit Visibility Photograph of Aircraft Army U-1	111
106	Binocular Cockpit Visibility Photograph of Aircraft Bell AH-1G	112
107	Binocular Cockpit Visibility Photograph of Aircraft Bell UH-1C	113
108	Binocular Cockpit Visibility Photograph of Aircraft Cessna CH-1	114
109	Binocular Cockpit Visibility Photograph of Aircraft Bell H-13G	115
110	Binocular Cockpit Visibility Photograph of Aircraft Sikorsky H-19	116
111	Binocular Cockpit Visibility Photograph of Aircraft Vertol H-21	117
112	Binocular Cockpit Visibility Photograph of Aircraft Hiller H-23	118
113	Binocular Cockpit Visibility Photograph of Aircraft Piasecki H-25A	119
114	Binocular Cockpit Visibility Photograph of Aircraft Doman H-31	120
115	Binocular Cockpit Visibility Photograph of Aircraft Sikorsky H-34	121

LIST OF ILLUSTRATIONS (Continued)

Figure		Page
116	Binocular Cockpit Visibility Photograph of Aircraft Sikorsky H-37	122
117	Binocular Cockpit Visibility Photograph of Aircraft Sikorsky HO5-1	123
118	Binocular Cockpit Visibility Photograph of Aircraft Kaman HOK-1	124
119	Binocular Cockpit Visibility Photograph of Aircraft Sikorsky HRS-3	125
120	Binocular Cockpit Visibility Photograph of Aircraft Hughes OH-6A	126
121	Binocular Cockpit Visibility Photograph of Aircraft Kaman K-20	127
122	Binocular Cockpit Visibility Photograph of Aircraft Sikorsky S-61L	128
123	Binocular Cockpit Visibility Photograph of Aircraft Sikorsky S-62	129
124	Binocular Cockpit Visibility Photograph of Aircraft Vertol 107	130
125	Binocular Cockpit Visibility Photograph of Aircraft Bell XH-40	131
126	Binocular Cockpit Visibility Photograph of Aircraft Vertol YCH-1B	132
127	Binocular Cockpit Visibility Photograph of Aircraft Sikorsky YCH-54A	133
128	Binocular Cockpit Visibility Photograph of Aircraft Bell X-22	134
129	Binocular Cockpit Visibility Photograph of Aircraft Lockheed XV-4A	135
130	Binocular Cockpit Visibility Photograph of Aircraft LTV XC-142A	136
131	Binocular Cockpit Visibility Photograph of Aircraft Ryan XV-5A	137

INTRODUCTION

Information contained in this publication is intended for those interested in promoting aviation safety; particularly, the prevention of midair collision. Many of the aircraft surveyed in this volume were involved in midair collisions. In some instances, the "other" aircraft was within the field of view afforded by the windshield design. Why those collisions were not avoided is a moot point. The concern here is that, in some of the collisions, one or both aircraft were obscured from each other by design limitations of their windshield such that, even if the crews were looking, they could not see each other (references 1 and 2).

Surveys were conducted to measure and record cockpit visibility. The standard means to accurately accomplish this task and allow for each interpretation of the effect of structural or equipment impairment to the field of vision is available and is known as the Federal Aviation Administration (FAA) Technical Center's Binocular Camera (figure 1).

DISCUSSION

Problems related to cockpit visibility received much attention in 1948 when two aircraft collided over New York City. About that time, the Civil Aeronautics Administration (CAA), predecessor of the Federal Aviation Administration (FAA), promulgated criteria prescribing the minimum field of vision acceptable for transport aircraft cockpit design. Inadequate means to measure and record cockpit visibility hampered implementation of this criteria, and therefore lead to the development of an instrument designed especially for this purpose. A standard means to accurately accomplish the task and allow each interpretation of structural or equipment impairment to the field of vision as seen by both eyes

of a pilot was sought. Consequently, such an instrument was developed and is known as the FAA Technical Center's Binocular Camera.

The vision criteria, still in use today after 30 years of aircraft evolution, are to be found in the Civil Aeronautics Manual 4B (CAM 4b) (reference 3). A comparison of standards (reference 4) contained in CAM 4b with those more recently established by the Society of Automotive Engineers (SAE) (reference 5), and the United States (U.S.) Military (reference 6), reveal that differences are generally insignificant. The FAA currently is seeking to adopt new criteria based on more recent studies (reference 7).

Over the years, because there has been considerable effort devoted to understanding the human capacity to "see," the related parameters that determine or affect human sight are very well documented. Blake and Fox (reference 8), in particular, reviewed the major experiments conducted and published in English during this century. They concentrated on the ability of the human visual system to unify two separate monocular fields of vision into a binocular cyclopic view that betrays little trace of its monocular origins. Clearly, the review found that binocular performance is far superior to monocular. For these reasons, and many others, the FAA Technical Center has decided to upgrade and enhance its capabilities of measuring cockpit visibility by designing and developing a new binocular camera. The new binocular camera will provide low-cost availability and facilitate deployment in the field.

Various manufacturers and FAA Regional Offices will be able to make more frequent use of the device during the development and final certification of the windshield system, accident investigation, and other applications such as research and development. Manufacturers expend large sums of money in the design

and development of their transparency systems. Problems become evident when an assessment of cockpit vision is held off until flight testing has begun or by reliance solely on engineering drawings or other graphic representation. All too often, the transparency systems are not in compliance with the standards of CAM 4b or even in agreement with the aircraft drawings. Why not verify and assess the design for visibility compliance during the development phase? This should include tests of a fullscale mockup as well as the finished aircraft. One or more design deficiencies have all too often resulted in considerable additional cost for redesign and requalification of the transparency system.

Officials are reticent to certificate cockpit visibility, for instance, based on just a seat-of-the-pants evaluation. They are now more inclined to be more receptive when adequate documentation is presented validating the manufacturer's product design. In this regard, the binocular camera leaves little or no room for subjective opinion.

Bearing in mind that CAM 4b merely recommends, as a minimum criteria, what cockpit visibility should be, underscores all the more reason why any compromise in visibility can be serious. For example, Captain F. H. Hawkins, who has for many years specialized in cockpit design and human factors, reported on the significance of pilots not properly making use of the visibility afforded them by the cockpit designer, and for which certification was based (reference 9). Aircraft cockpit design is based on anthropometric dimensions, particularly that point in space called the eye space or design eye reference point (DERP). Unfortunately, even in well designed aircraft, visibility problems are induced when optimum available visibility is abrogated by the pilot's failure to position his eye at this DERP.

McDonnell-Douglas, in an operational support bulletin (reference 10), has advised pilots that, for sitting below the DERP, each centimeter results in a 1.4° loss in downward vision over the nose. This loss of downward vision affects how much, if any, of the runway would be visible and becomes very important during a low-visibility approach. In addition, an illusion may be created whereby a pilot seated below the DERP may misjudge his height at landing, and sometimes land short or too hard.

The FAA Technical Center's Binocular Camera was instrumental in determining contributing factors in a midair collision over San Diego which occurred on September 25, 1978, between a Boeing 727 and Cessna 172. Binocular photographs were taken from both aircraft cockpits. Additional information regarding position, orientation, time, altitude, airspeed, etc., was utilized to calculate the perspective vision angles and range between both aircraft using a computer. The resulting calculations were plotted onto the binocular photographs of the field of vision of the respective aircraft. Each photograph consequently contained the track or position of the target aircraft with respect to the particular field of vision available just seconds prior to impact. Through this process, the binocular photographs allow investigators to better comprehend the visibility each pilot had.

EQUIPMENT DESCRIPTION.

Assembled on its tripod, the binocular camera weighs 46 pounds and has overall dimensions of 15 inches in width, 15 1/2 inches in depth, and 35 3/4 inches in height. Tripod legs are used for initial leveling and adapting the camera to various cockpit floor configurations; final leveling is accomplished by use of leveling screws. In operation, a

self-contained battery pack drives the camera in a clockwise rotation while film moves at a precise speed past a vertical slot used for an aperture. The film speed, aperture width, and rotation speed are critically dependent upon each other to produce satisfactory results. Figure 2 is a schematic showing the optical system arrangement. The camera uses two 65 millimeter wide-angle F6.8 lenses, and covers an 88 1/2° field of vision. Matched lenses of identical focal length were selected and mounted on a flat surface so that their optical axes are parallel. The distance between the axes is 2.5 inches, representing the average human interocular spacing.

SURVEY PROCEDURE.

In order to accomplish a cockpit vision survey using the binocular camera, an aircraft is parked with an unobstructed view of the horizon (figure 3). Using manufacturer drawings of the cockpit geometry, a DERP is determined, and the camera is positioned at this location. A 1-inch round marker is applied to the windshield at a point that lies along an extension of a line-of-sight drawn from the DERP. This marker can later be identified on photographs, and is the "zero reference" point from which measurements are taken (figure 4).

Once set up, the camera (figure 5) can produce a photographic record of the field of vision of a pilot as he turns his head from extreme left to extreme right. Superimposed on the photograph is a grid of horizontal and vertical lines in 5-degree increments. This grid with the "zero reference" mark allows angular measurements to be made. The images produced are representative of what the human eyes see before the brain integrates them into one. Thus, the effect of obstructions to vision may be analyzed. The camera rotates about a vertical axis that is normally located 3.3 inches aft from the lenses. In this "normal" position, the dimension

corresponds to the mean distance between the front of the human eyes and the odontoid process; i.e., the pivot about which the skull rotates in the vertebral column (figure 6). By moving the camera to a position as shown in figure 7, the lenses now rotate about an 8.3-inch radius, and is called the "alert" position, which represents the generally accepted additional 5 inches that a pilot leans forward from the "normal" while in a search for other traffic.

BINOCULAR VISION.

Binocular vision is the ability to see "around" vertical obstructions under certain conditions. The width of the obstruction or target, the relative positions of the observer, and the obstruction or target determine whether or not a target is visible. Figure 8 illustrates the twin lenses (eyes) of the binocular camera as it sees a target at infinity around a vertical obstruction of 2.5 inches or less in width. In this example, the target is visible, in part, to both eyes. If the target were to advance into the opaque zone, it would be obstructed from view. If the target were then to bank left or right into the gray zone, the target would become visible to one eye only.

Over the years that the binocular camera has been in existence, many cockpit vision surveys were completed for certification, accident investigation, and research and development studies. In all, the key factor was and is visibility. Regardless of aircraft or equipment in use, or how capable the pilot may be, safety of flight depends on his ability to receive visual cues and information from an internal display or externally through the windshield system.

Since a great percentage of accidents are crew related, one area of improvement in the overall complexity of a modern transport that should take place is in the flight deck, the nerve center

for the management of these flight systems, many of which depend on the pilot's ability to receive visual information.

AUTHORS COMMENT.

No claim of librarianship is made. The style of listing is intended to facilitate publication and to provide maximum utility with some consistency. Annotations are descriptive rather than evaluative. Journalistic comment occurs where it may provide background information on, or identify associated reference documents of, public record. Figures 9 through 131 are the results of the binocular cockpit vision surveys.

REFERENCES

1. Aircraft Pilot Warning Instrument (APWI), a study by W. Graham, Report Number FAA-RD-75-59, 1, March 1975.

2. Parker L. C., General Aviation Air Traffic Pattern Safety Analysis, Report Number NASA TM-X-6955, July 1973.

3. Civil Aeronautics Manual (CAM) 4b, pages 351-353, 1952.

4. Goldin R. W., Cockpit Vision Requirements Review, for the Air Safety Foundation, Aircraft Owners and Pilots Association, April 1, 1971.

5. Society of Automotive Engineers (SAE), Aeronautical Specification 580B.SAE Aerospace Recommended Practice 268E.

6. Aircraft Station Vision Requirements for Military Aircraft, Military Standard 850B, November 3, 1970.

7. Draft Advisory Circular 25.773-8, April 24, 1980.

8. The Psychophysical Inquiry into Binocular Simulation, Perception and Psychophysics, Volume 14, Number 1, Pages 161-185, 1973.

9. Hawkins, F. H., Captain, The Pilot's Cockpit Visibility, for Shell Aviation News, Volume 440, 1977.

10. Know Your DC-10, by McDonnell-Douglas, letter Number 56, February 20, 1975.

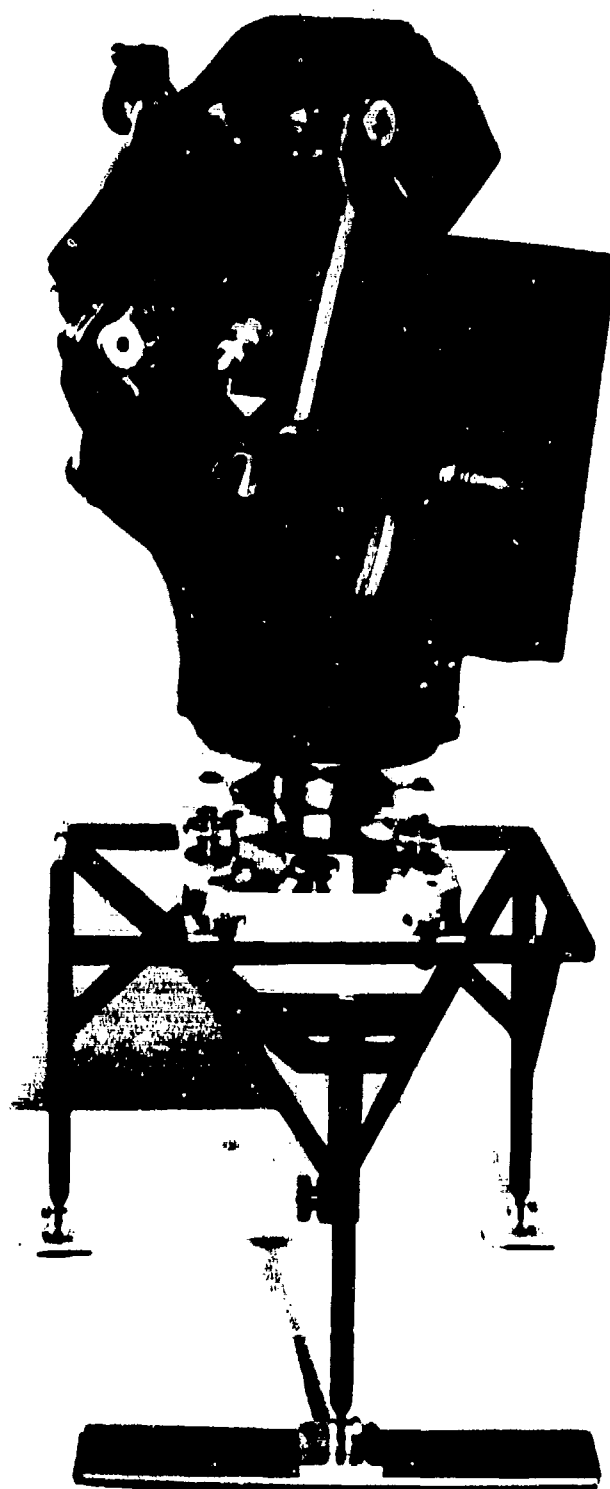
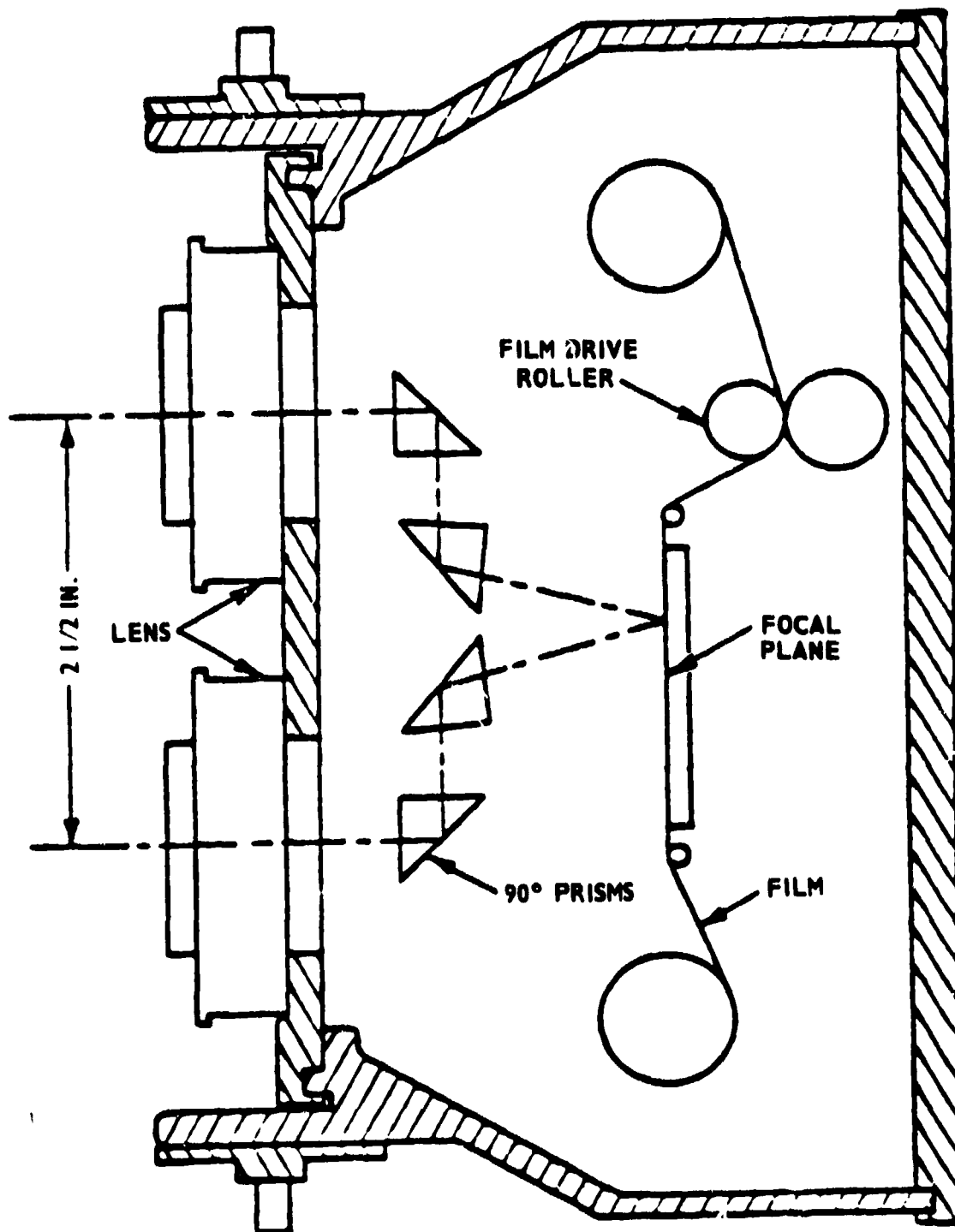


FIGURE 1. FAA TECHNICAL CENTER BINOCULAR CAMERA



SECTION THROUGH CAMERA SHOWING
OPTICAL ARRANGEMENT.

FIGURE 2. SECTION THROUGH CAMERA SHOWING OPTICAL ARRANGEMENT

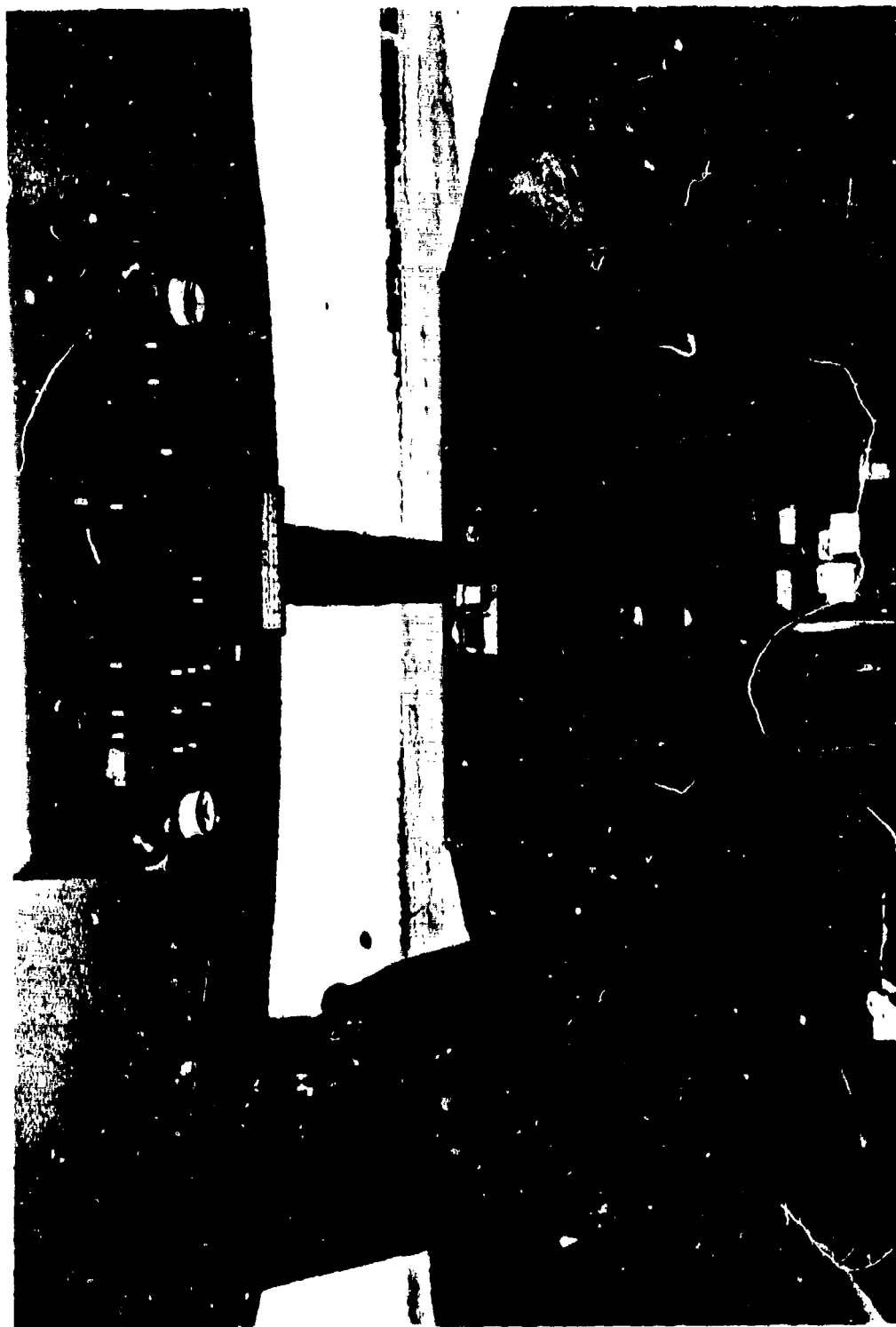
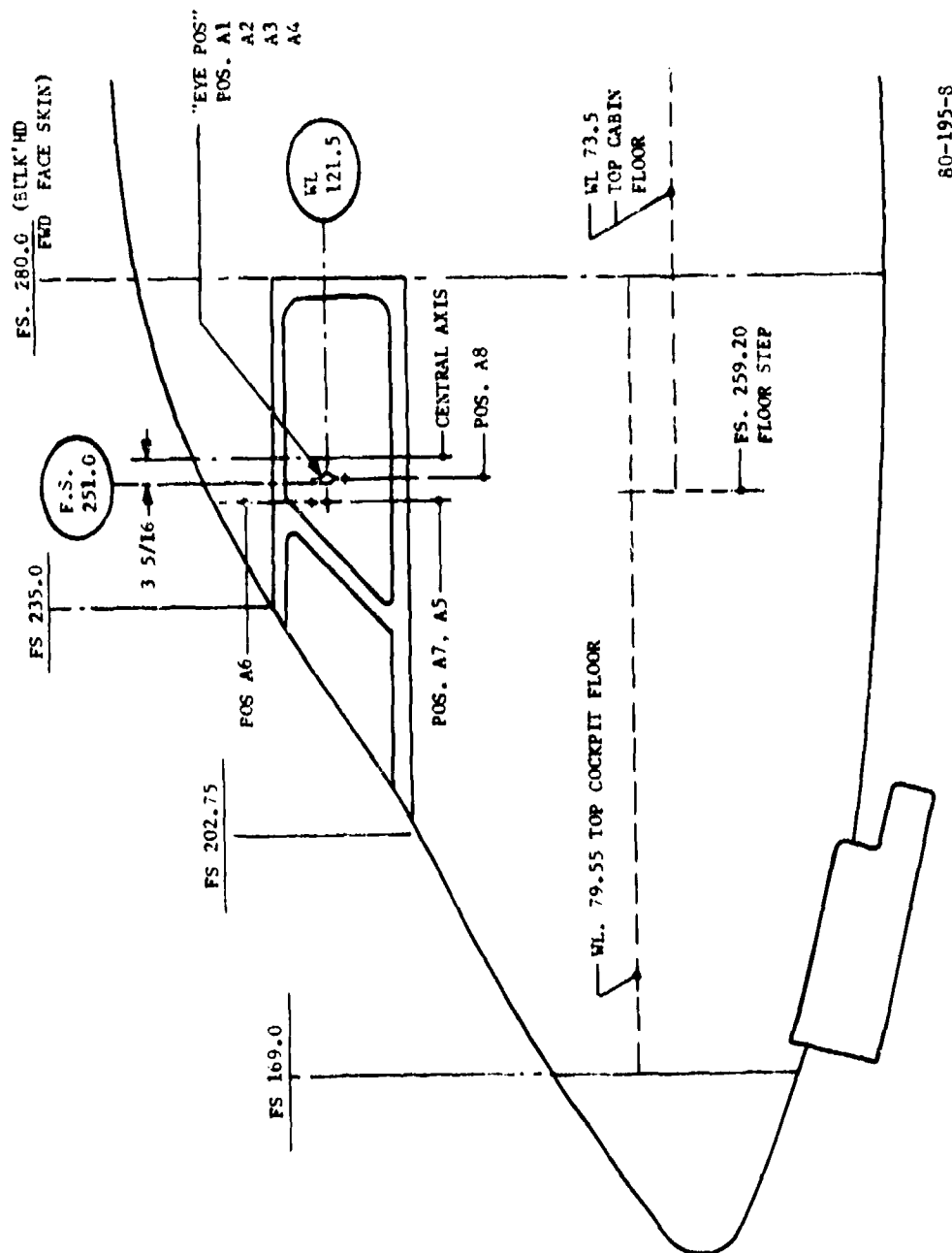


FIGURE 3. CL-600 COCKPIT WITH BINOCULAR CAMERA



80-195-8

FIGURE 4. CL-600 LEFT SIDE VIEW

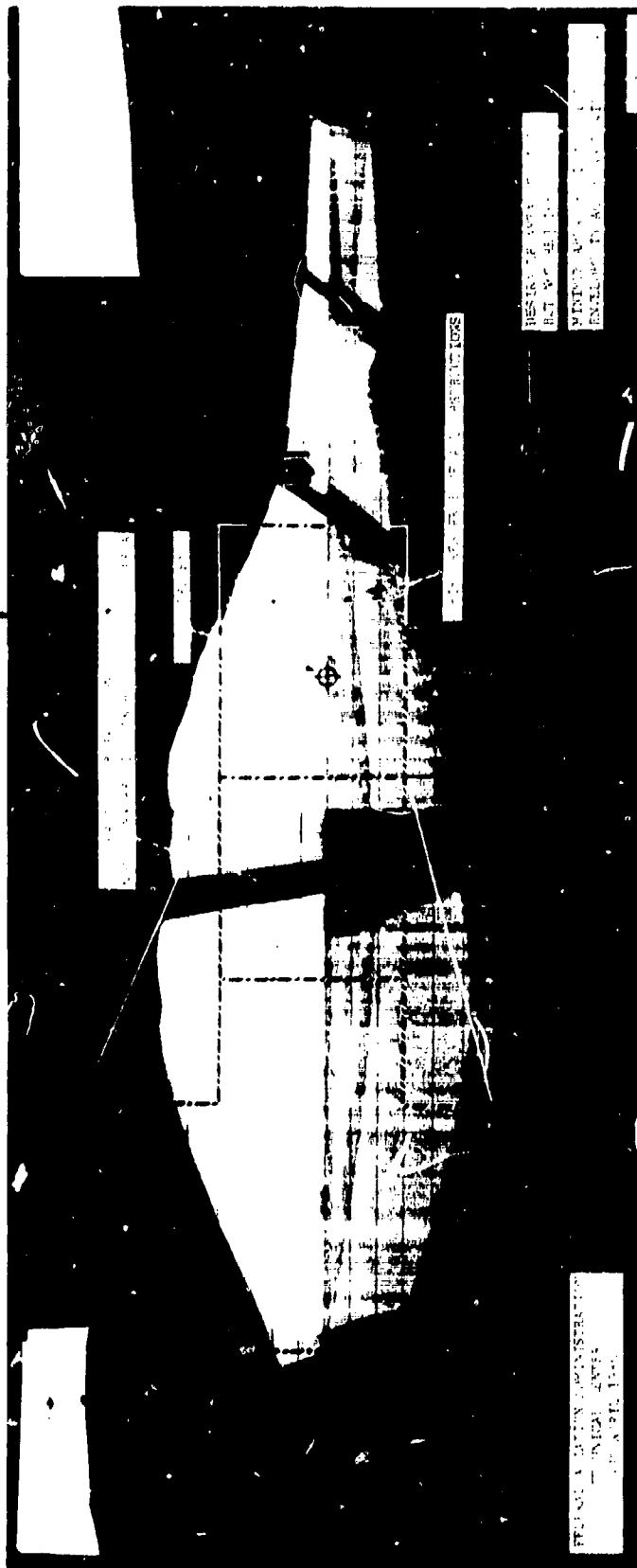
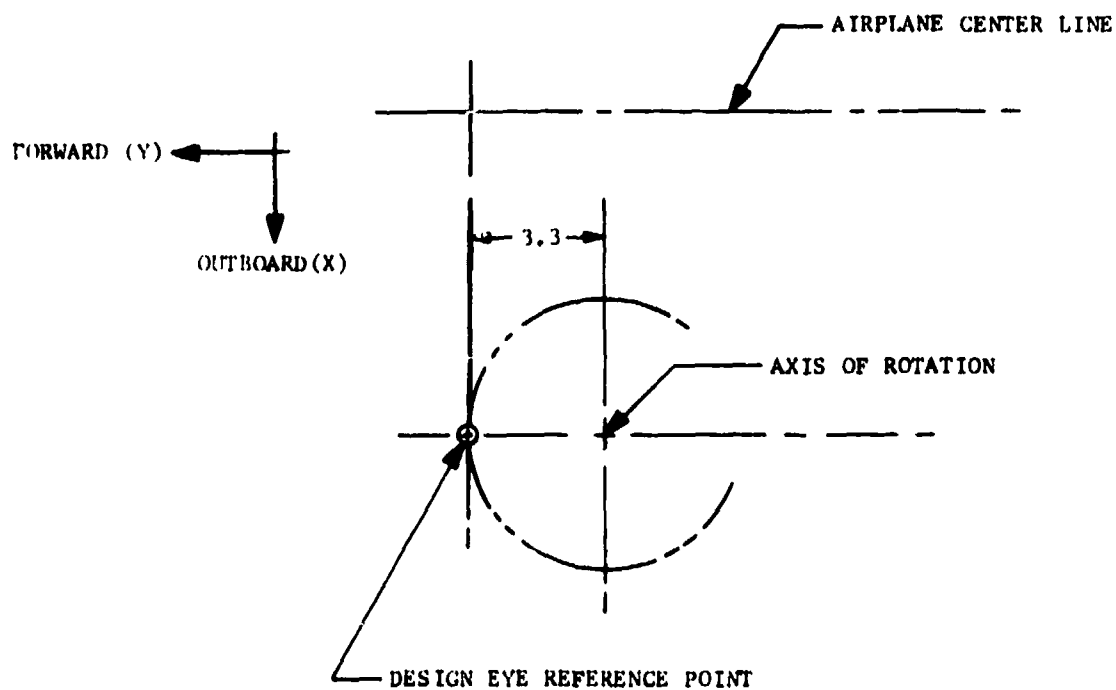
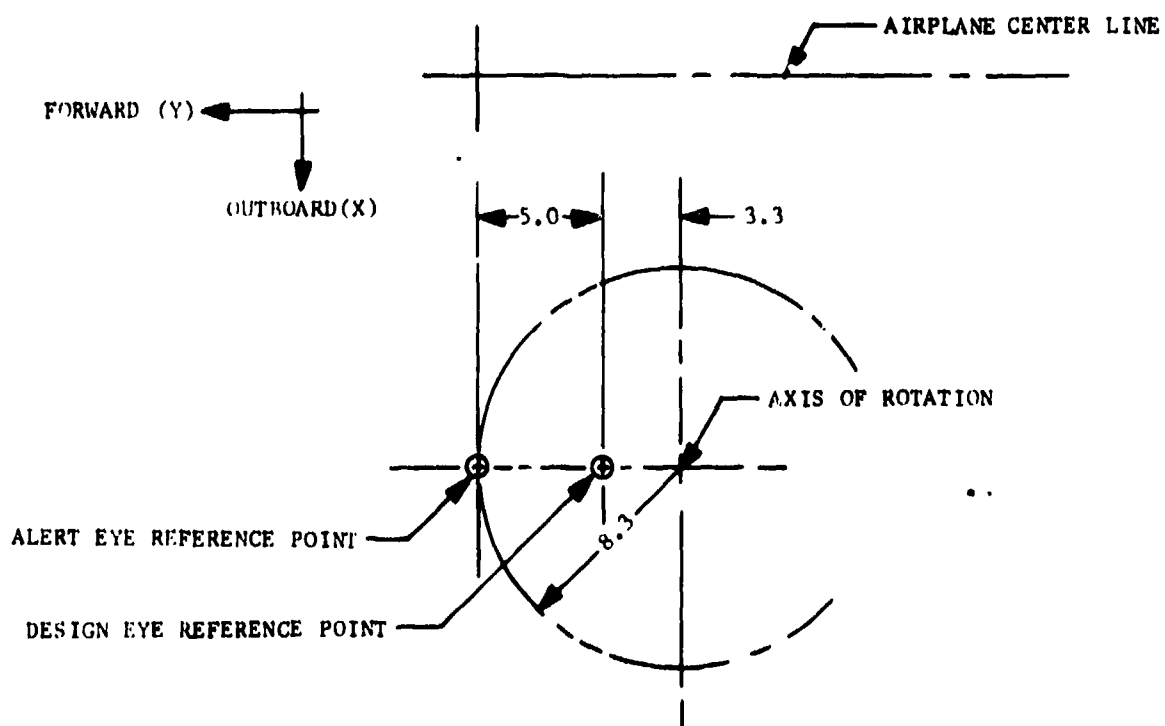


FIGURE 5. PILOTS EYE POSITION



80-195-4

FIGURE 6. NORMAL DESIGN EYE REFERENCE POINT



80-195-5

FIGURE 7. ALERT DESIGN EYE REFERENCE POINT

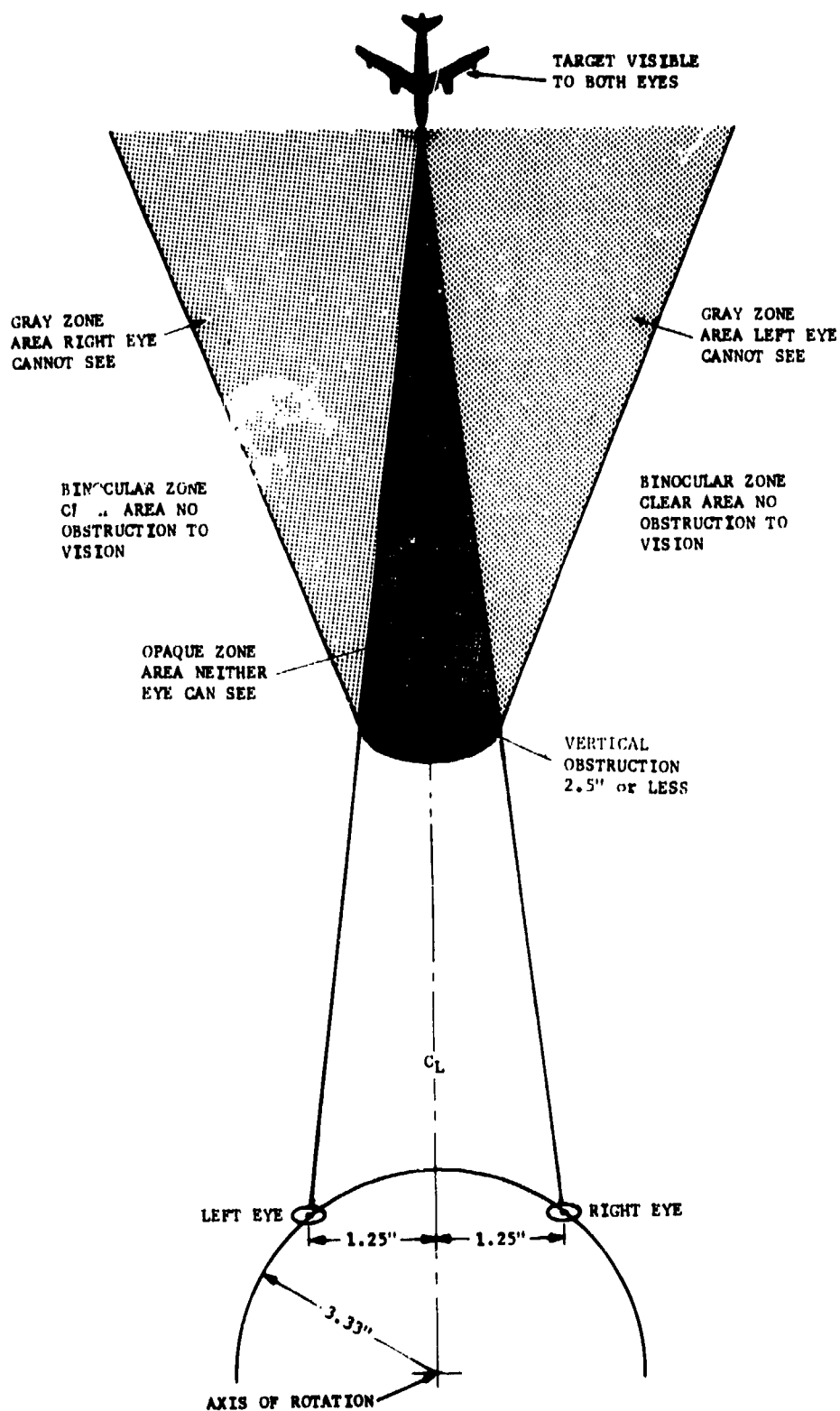


FIGURE 8. BINOCULAR VISION

CIVILIAN AIRCRAFT
Above 12,500 pounds

The aircraft in the following listing are depicted in figures 9 through 48.

Aero 1121	Fairchild F-27
Boeing 707	Fairchild FH-227
Boeing 727	Falcon Fan Jet 20
Boeing 727-200	Gates Lear Jet Model 24
Boeing 747	Gates Lear Jet Mockup 35/36
Canadair CL-44	Gates Lear Jet 55
Canadair Challenger CL-600	Grumman Gulfstream
Cessna 620	Howard Model 500
Cessna Citation III	Lockheed Electra
Convair 240	Lockheed Jetstar
Convair 340	Lockheed L-1049A
Convair 580	Lockheed Model 300
Convair 880	Martin 404
Curtiss Model 200	Mitsubishi 300
Douglas DC-3	NASA/Boeing-737
Douglas DC-4	Sunrise S-1600
Douglas DC-6	Super G. Constellation
Douglas DC-7	Vickers Viscount
Douglas DC-8	
Douglas DC-9	
Douglas DC-9-50	
Douglas DC-9-80	



FIGURE 9. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AERO COMMANDER 1121



FIGURE 10. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BOEING 707



FIGURE 11. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BOEING 727

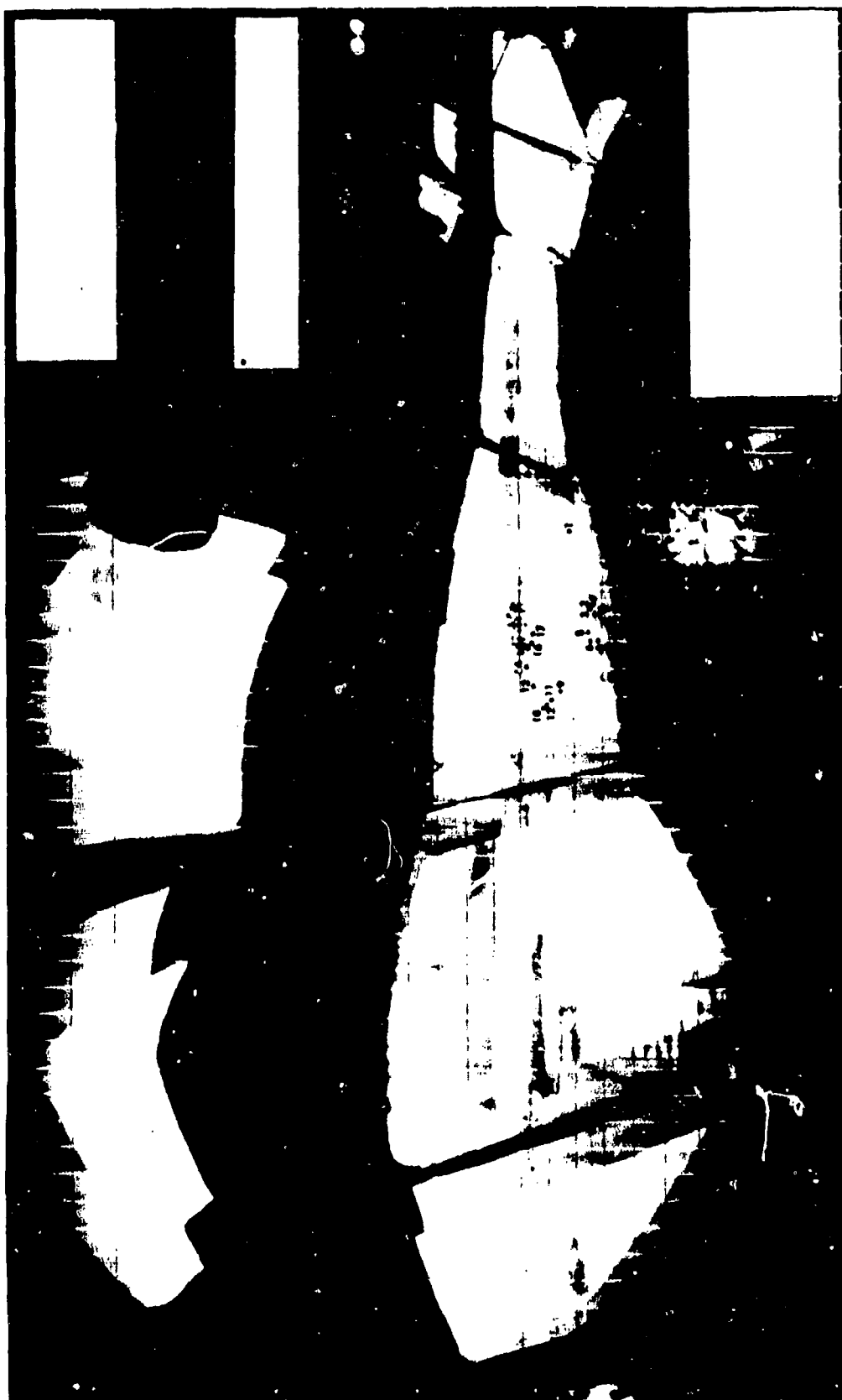


FIGURE 12. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BOEING 727-200



FIGURE 13. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BOEING 747



FIGURE 14. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CANADAIR, LTD., CL-44



FIGURE 15. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CANADAIR CHALLENGER CL-600

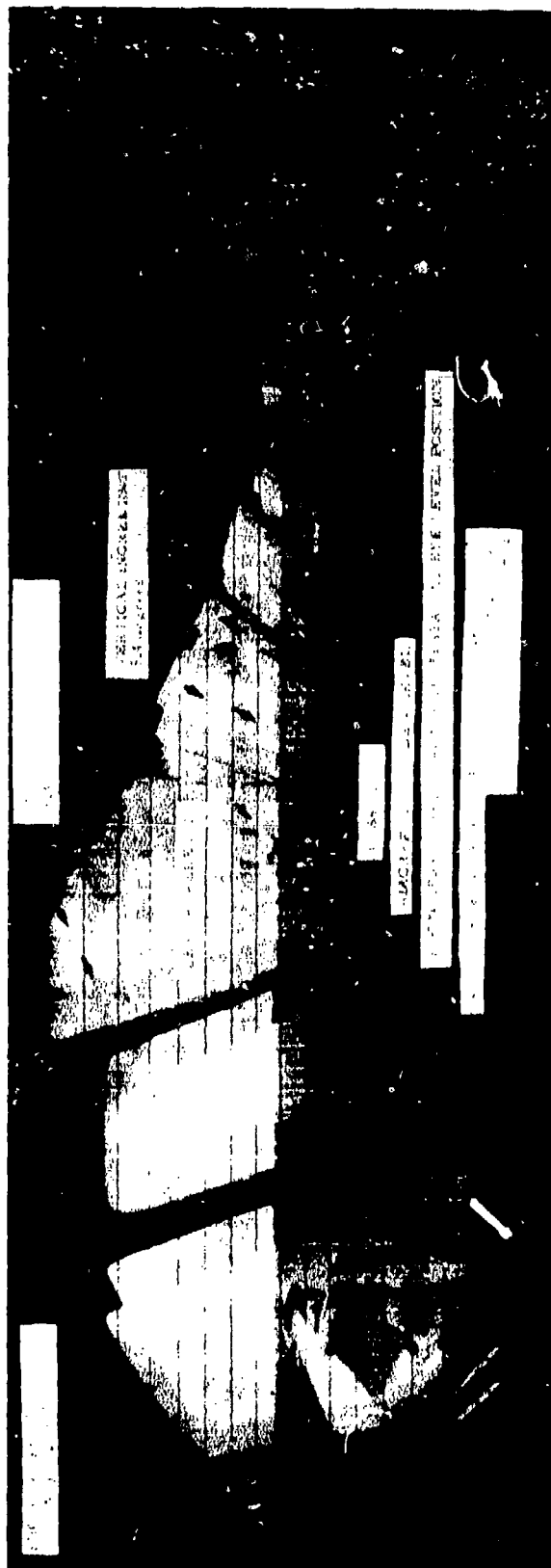


FIGURE 16. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 620

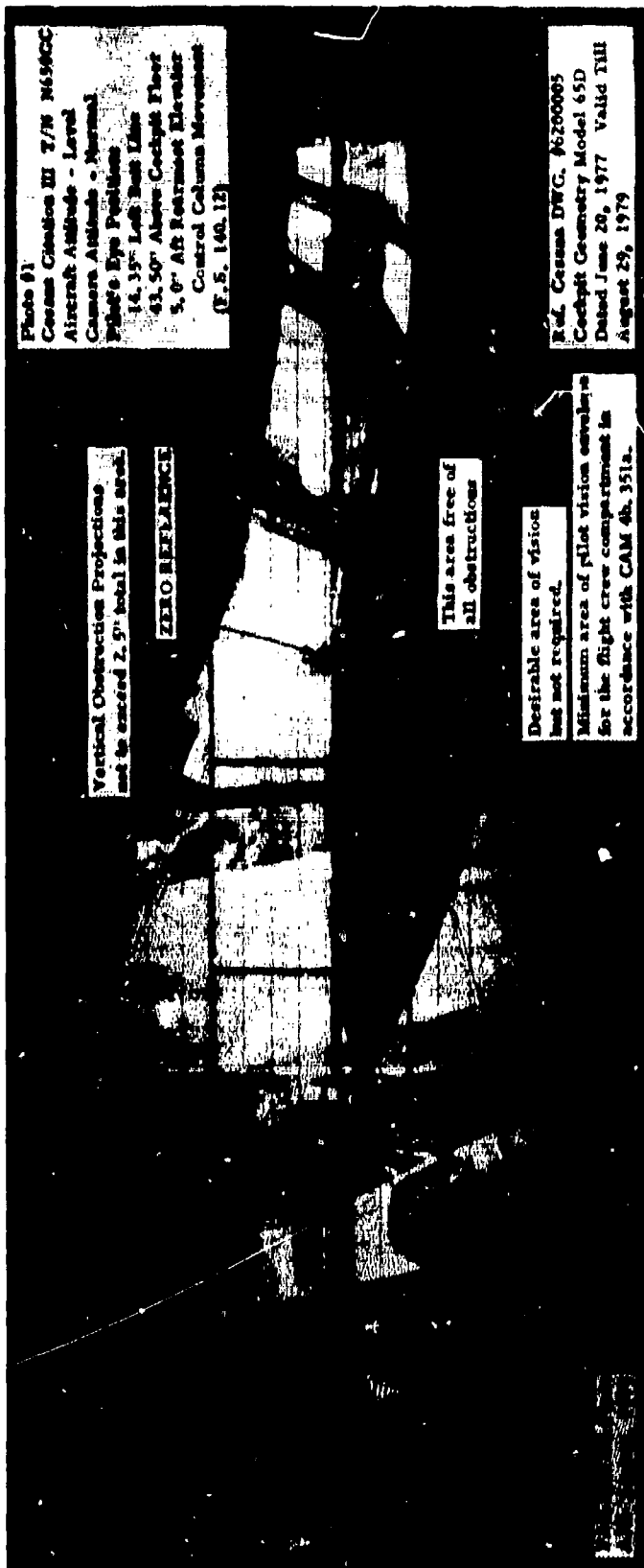


FIGURE 17. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA CITATION III

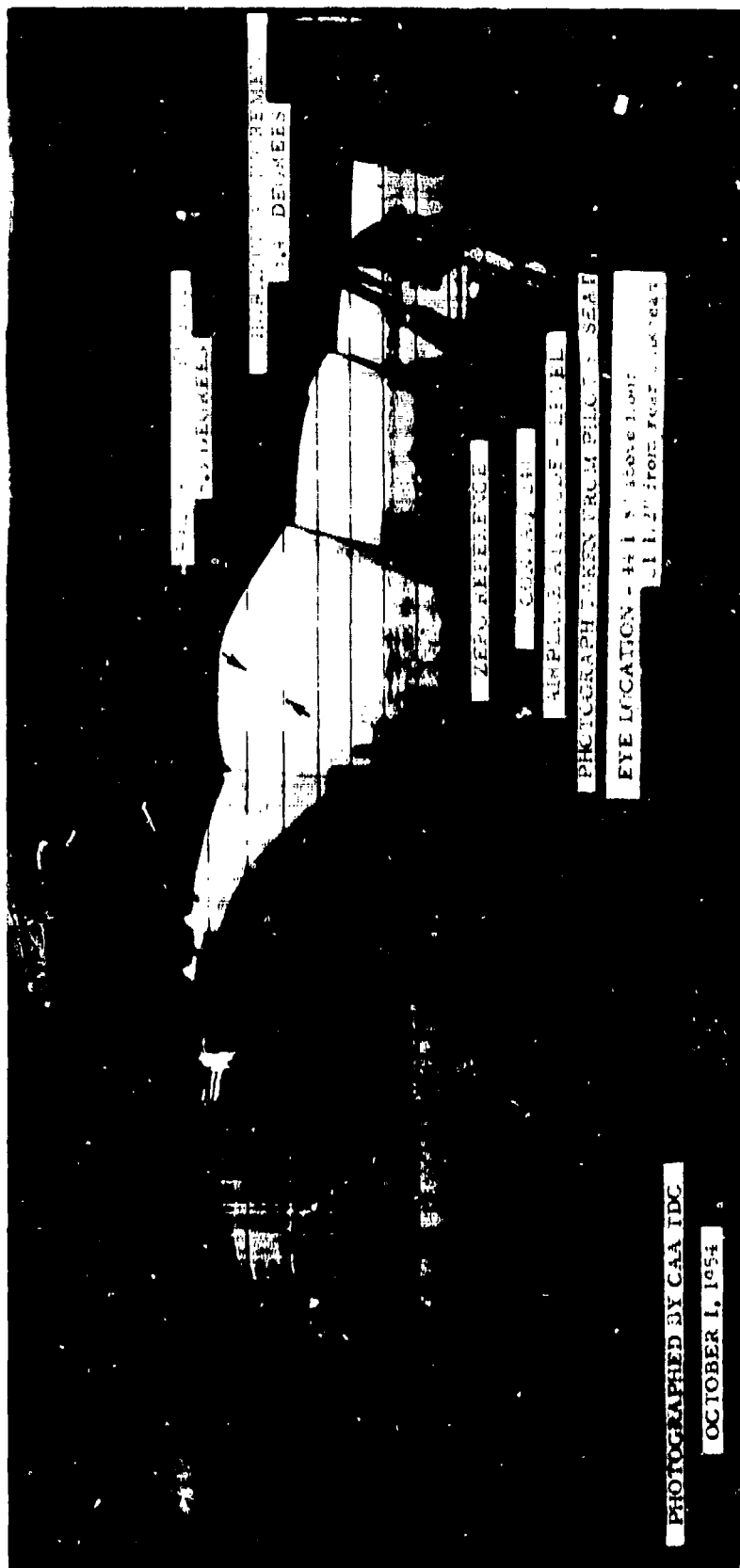


FIGURE 18. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CONVAIR 240

7-10-68
24 MAY 68
25 MAY 68
26 MAY 68
27 MAY 68
28 MAY 68
29 MAY 68
30 MAY 68
31 MAY 68
1 JUN 68
2 JUN 68
3 JUN 68
4 JUN 68
5 JUN 68
6 JUN 68
7 JUN 68
8 JUN 68
9 JUN 68
10 JUN 68
11 JUN 68
12 JUN 68
13 JUN 68
14 JUN 68
15 JUN 68
16 JUN 68
17 JUN 68
18 JUN 68
19 JUN 68
20 JUN 68
21 JUN 68
22 JUN 68
23 JUN 68
24 JUN 68
25 JUN 68
26 JUN 68
27 JUN 68
28 JUN 68
29 JUN 68
30 JUN 68
1 JUL 68
2 JUL 68
3 JUL 68
4 JUL 68
5 JUL 68
6 JUL 68
7 JUL 68
8 JUL 68
9 JUL 68
10 JUL 68
11 JUL 68
12 JUL 68
13 JUL 68
14 JUL 68
15 JUL 68
16 JUL 68
17 JUL 68
18 JUL 68
19 JUL 68
20 JUL 68
21 JUL 68
22 JUL 68
23 JUL 68
24 JUL 68
25 JUL 68
26 JUL 68
27 JUL 68
28 JUL 68
29 JUL 68
30 JUL 68
31 JUL 68
1 AUG 68
2 AUG 68
3 AUG 68
4 AUG 68
5 AUG 68
6 AUG 68
7 AUG 68
8 AUG 68
9 AUG 68
10 AUG 68
11 AUG 68
12 AUG 68
13 AUG 68
14 AUG 68
15 AUG 68
16 AUG 68
17 AUG 68
18 AUG 68
19 AUG 68
20 AUG 68
21 AUG 68
22 AUG 68
23 AUG 68
24 AUG 68
25 AUG 68
26 AUG 68
27 AUG 68
28 AUG 68
29 AUG 68
30 AUG 68
31 AUG 68
1 SEP 68
2 SEP 68
3 SEP 68
4 SEP 68
5 SEP 68
6 SEP 68
7 SEP 68
8 SEP 68
9 SEP 68
10 SEP 68
11 SEP 68
12 SEP 68
13 SEP 68
14 SEP 68
15 SEP 68
16 SEP 68
17 SEP 68
18 SEP 68
19 SEP 68
20 SEP 68
21 SEP 68
22 SEP 68
23 SEP 68
24 SEP 68
25 SEP 68
26 SEP 68
27 SEP 68
28 SEP 68
29 SEP 68
30 SEP 68
1 OCT 68
2 OCT 68
3 OCT 68
4 OCT 68
5 OCT 68
6 OCT 68
7 OCT 68
8 OCT 68
9 OCT 68
10 OCT 68
11 OCT 68
12 OCT 68
13 OCT 68
14 OCT 68
15 OCT 68
16 OCT 68
17 OCT 68
18 OCT 68
19 OCT 68
20 OCT 68
21 OCT 68
22 OCT 68
23 OCT 68
24 OCT 68
25 OCT 68
26 OCT 68
27 OCT 68
28 OCT 68
29 OCT 68
30 OCT 68
31 OCT 68
1 NOV 68
2 NOV 68
3 NOV 68
4 NOV 68
5 NOV 68
6 NOV 68
7 NOV 68
8 NOV 68
9 NOV 68
10 NOV 68
11 NOV 68
12 NOV 68
13 NOV 68
14 NOV 68
15 NOV 68
16 NOV 68
17 NOV 68
18 NOV 68
19 NOV 68
20 NOV 68
21 NOV 68
22 NOV 68
23 NOV 68
24 NOV 68
25 NOV 68
26 NOV 68
27 NOV 68
28 NOV 68
29 NOV 68
30 NOV 68
1 DEC 68
2 DEC 68
3 DEC 68
4 DEC 68
5 DEC 68
6 DEC 68
7 DEC 68
8 DEC 68
9 DEC 68
10 DEC 68
11 DEC 68
12 DEC 68
13 DEC 68
14 DEC 68
15 DEC 68
16 DEC 68
17 DEC 68
18 DEC 68
19 DEC 68
20 DEC 68
21 DEC 68
22 DEC 68
23 DEC 68
24 DEC 68
25 DEC 68
26 DEC 68
27 DEC 68
28 DEC 68
29 DEC 68
30 DEC 68
31 DEC 68

333

卷之四

[illegible]

THE UNIVERSITY OF CHICAGO

THE NEW YORK PUBLIC LIBRARY

SPIN AND HORIZONTAL INCREMENT 5°

THE NEW YORK PUBLIC LIBRARY

6-131 COWLEY MO
AIRPORT ATTERLEY - LOWELL

PHOTO BY FAA-NAFEC
SEPTEMBER 1959

FIGURE 19. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CONVAIR 340

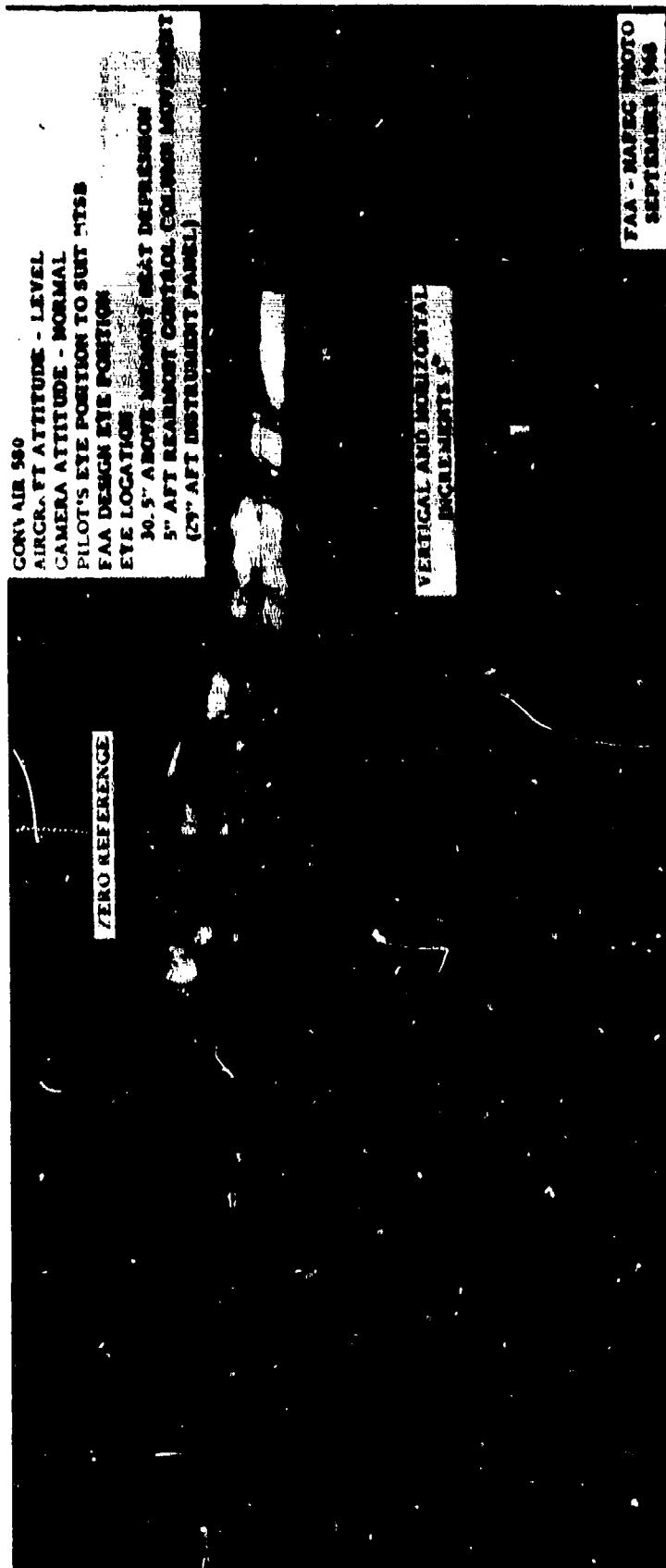


FIGURE 20. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CONVAIR 580

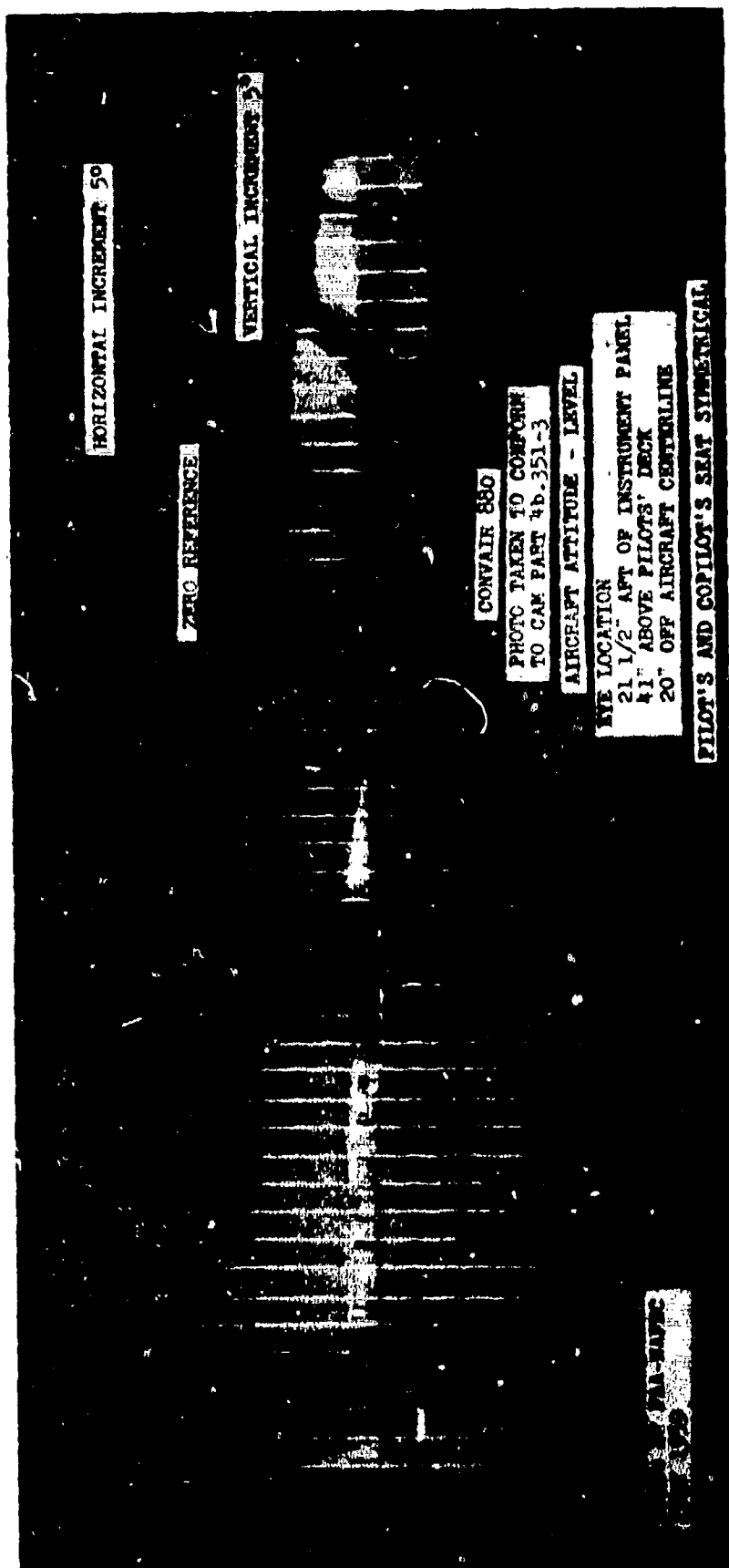


FIGURE 21. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CONVAIR 880



FIGURE 22. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CURTISS-WRIGHT 200

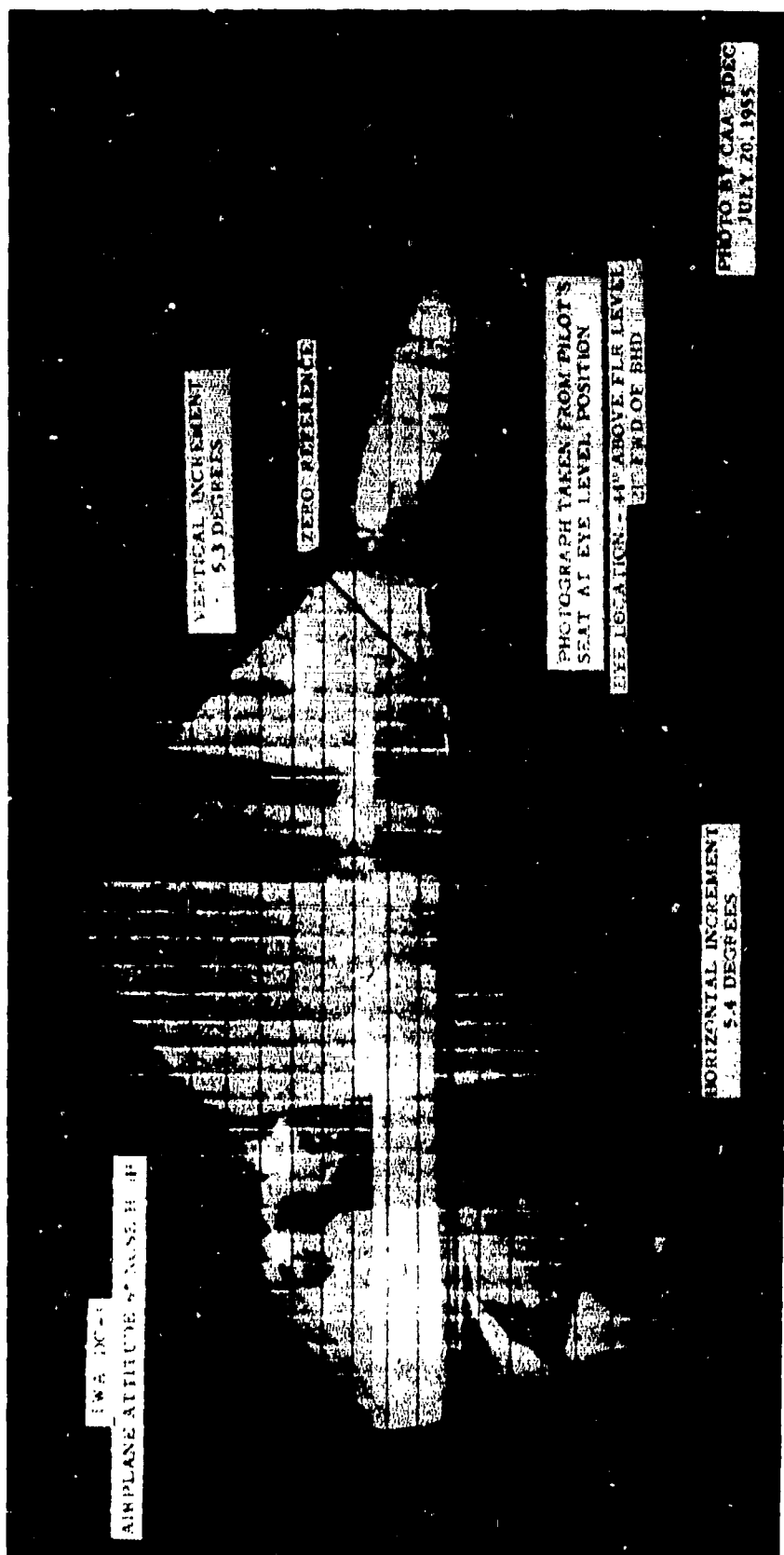


FIGURE 23. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DOUGLAS DC-3

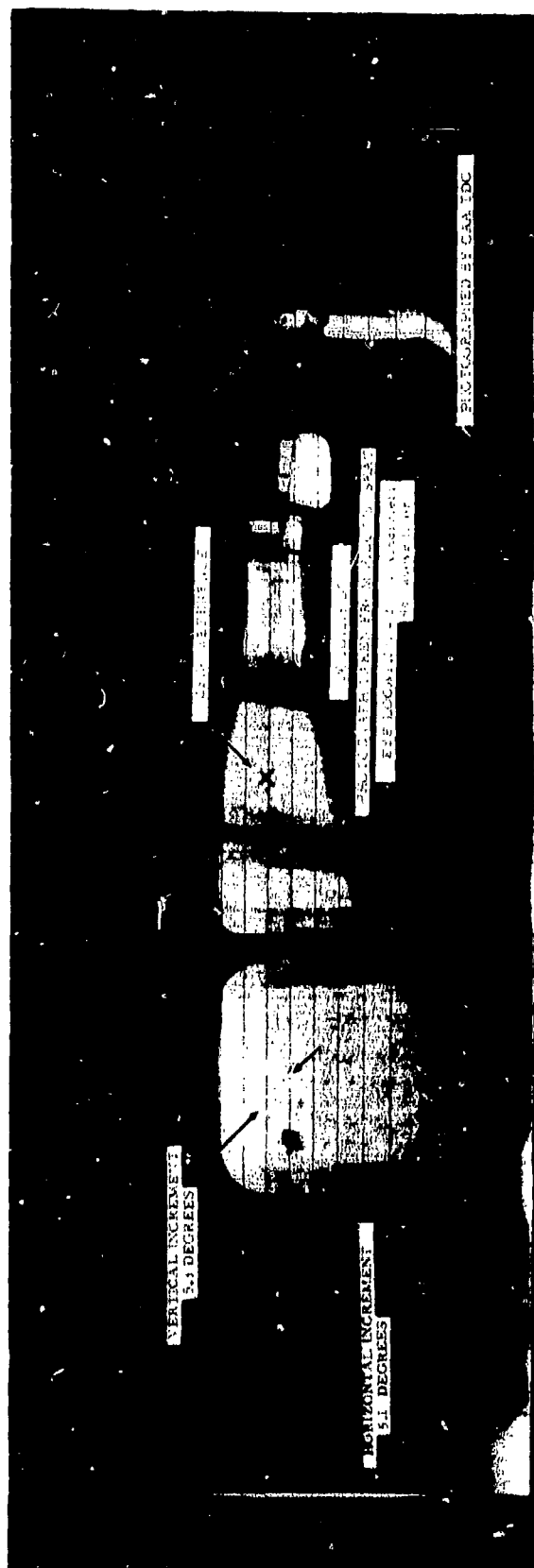


FIGURE 25. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DOUGLAS DC-6

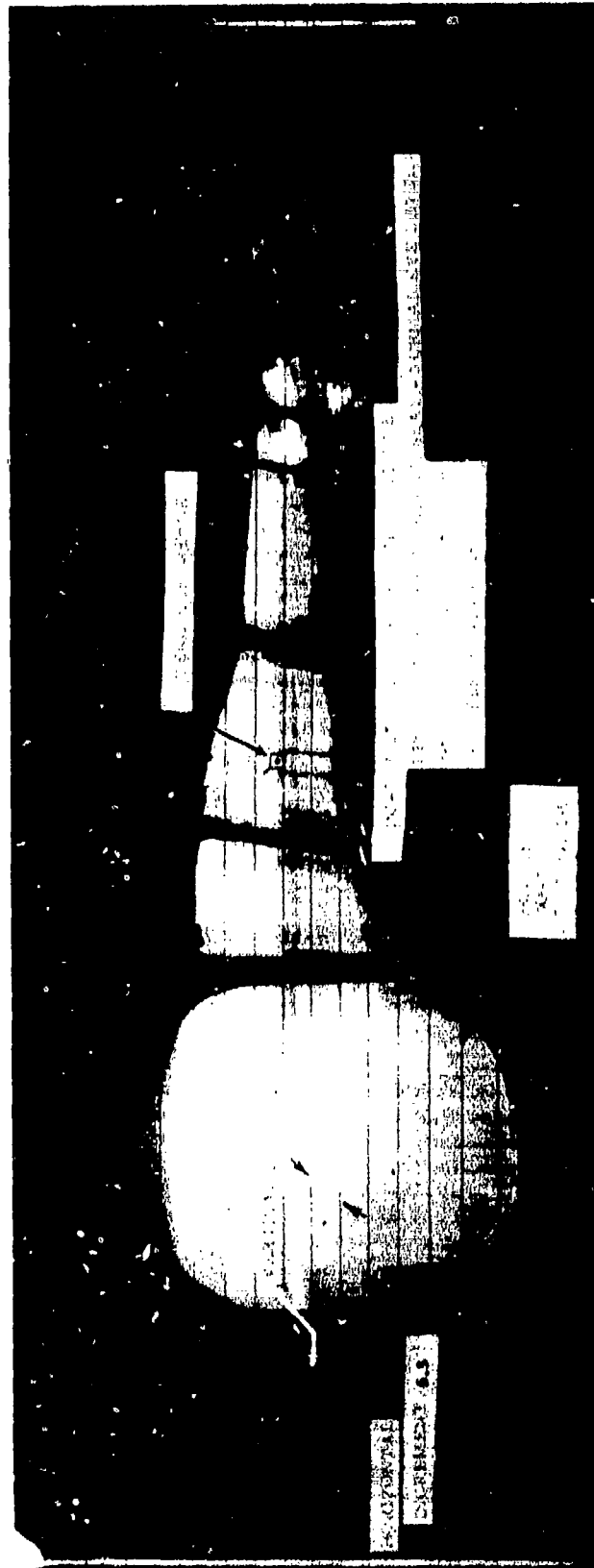


FIGURE 26. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DOUGLAS DC-7



FIGURE 27. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DOUGLAS DC-8

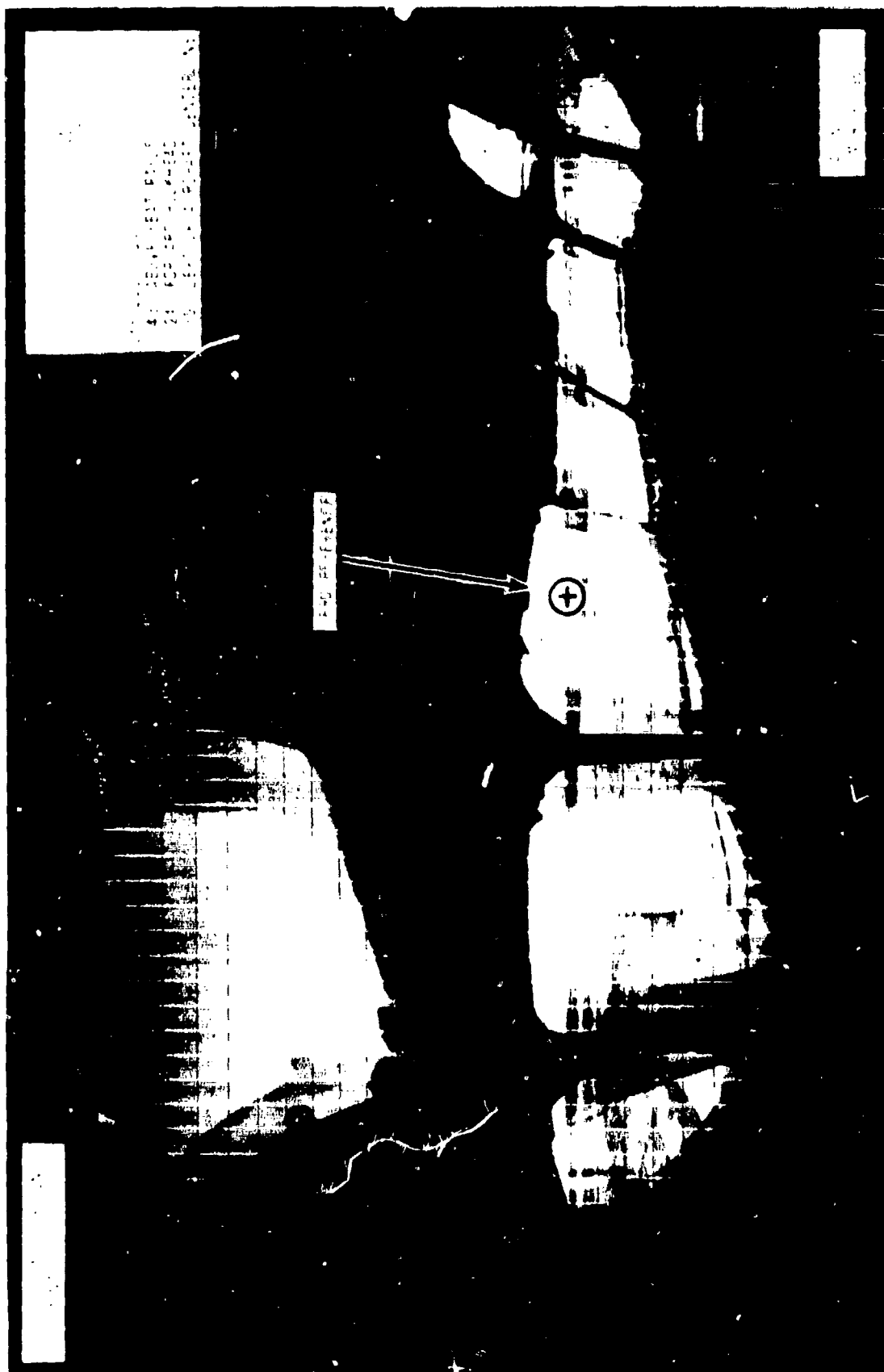


FIGURE 28. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DOUGLAS DC-9

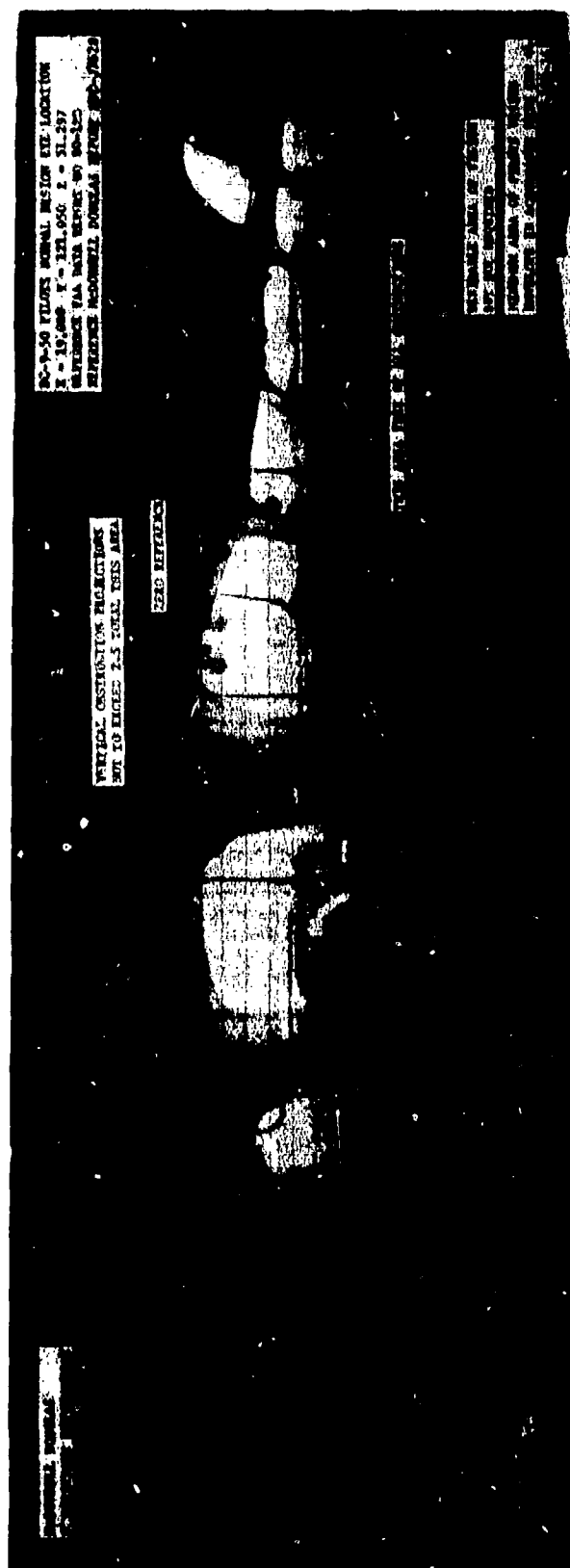


FIGURE 29. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DOUGLAS DC-9-50

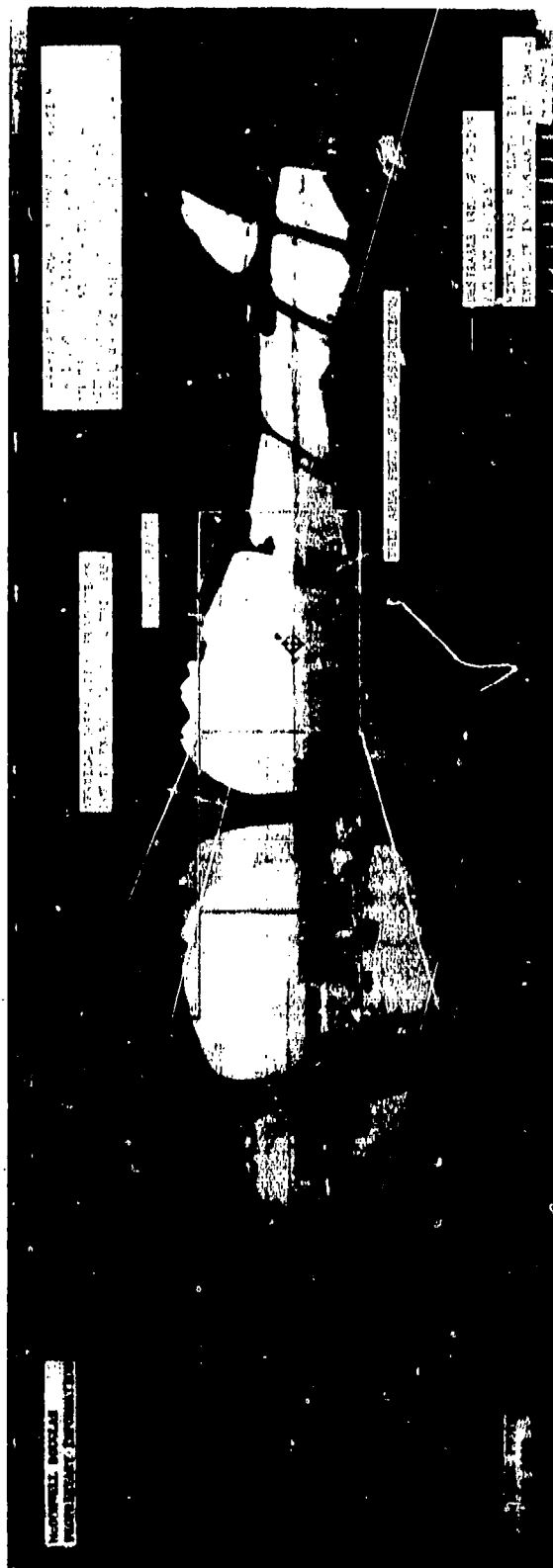


FIGURE 30. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DOUGLAS DC-9-80

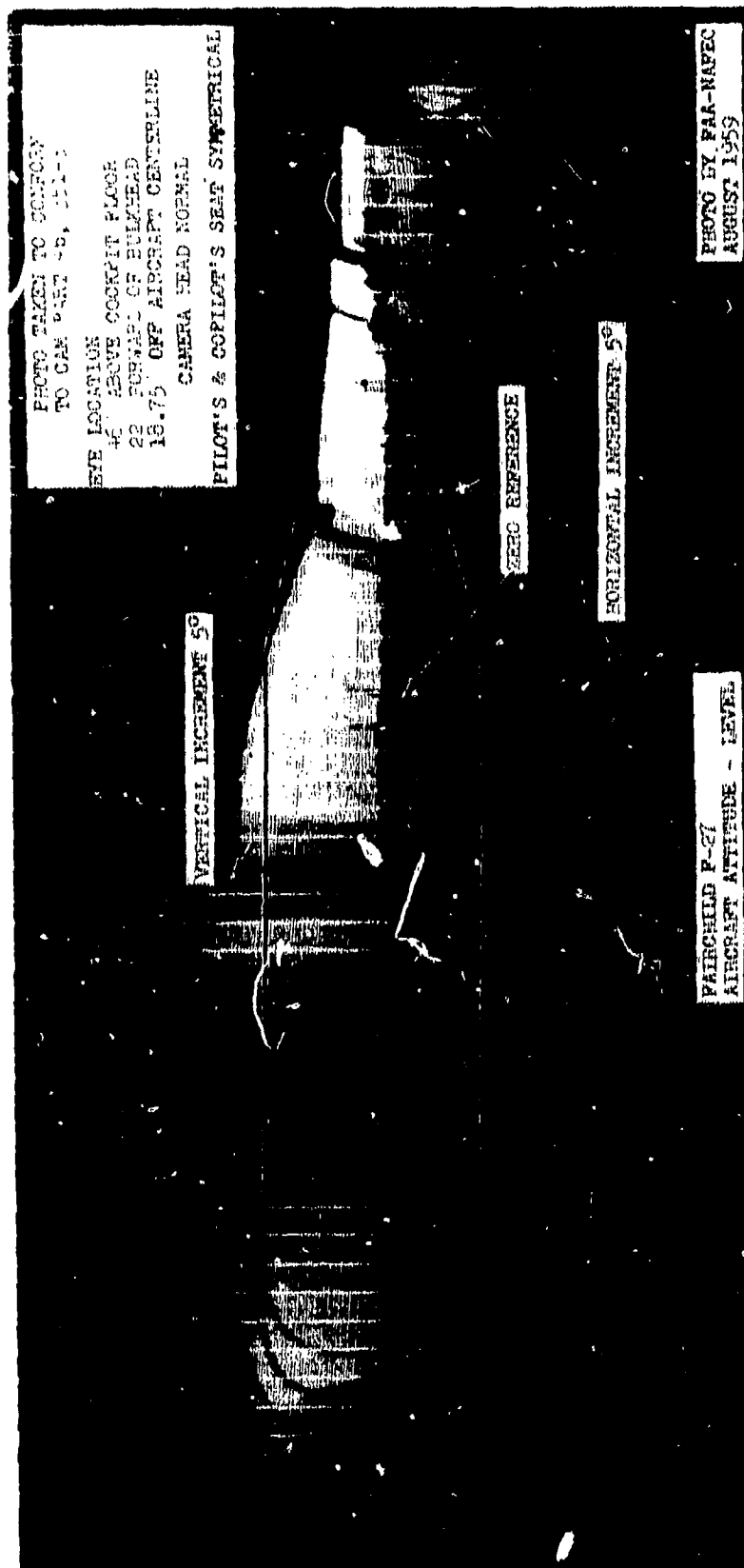


FIGURE 31. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT FAIRCHILD P-27

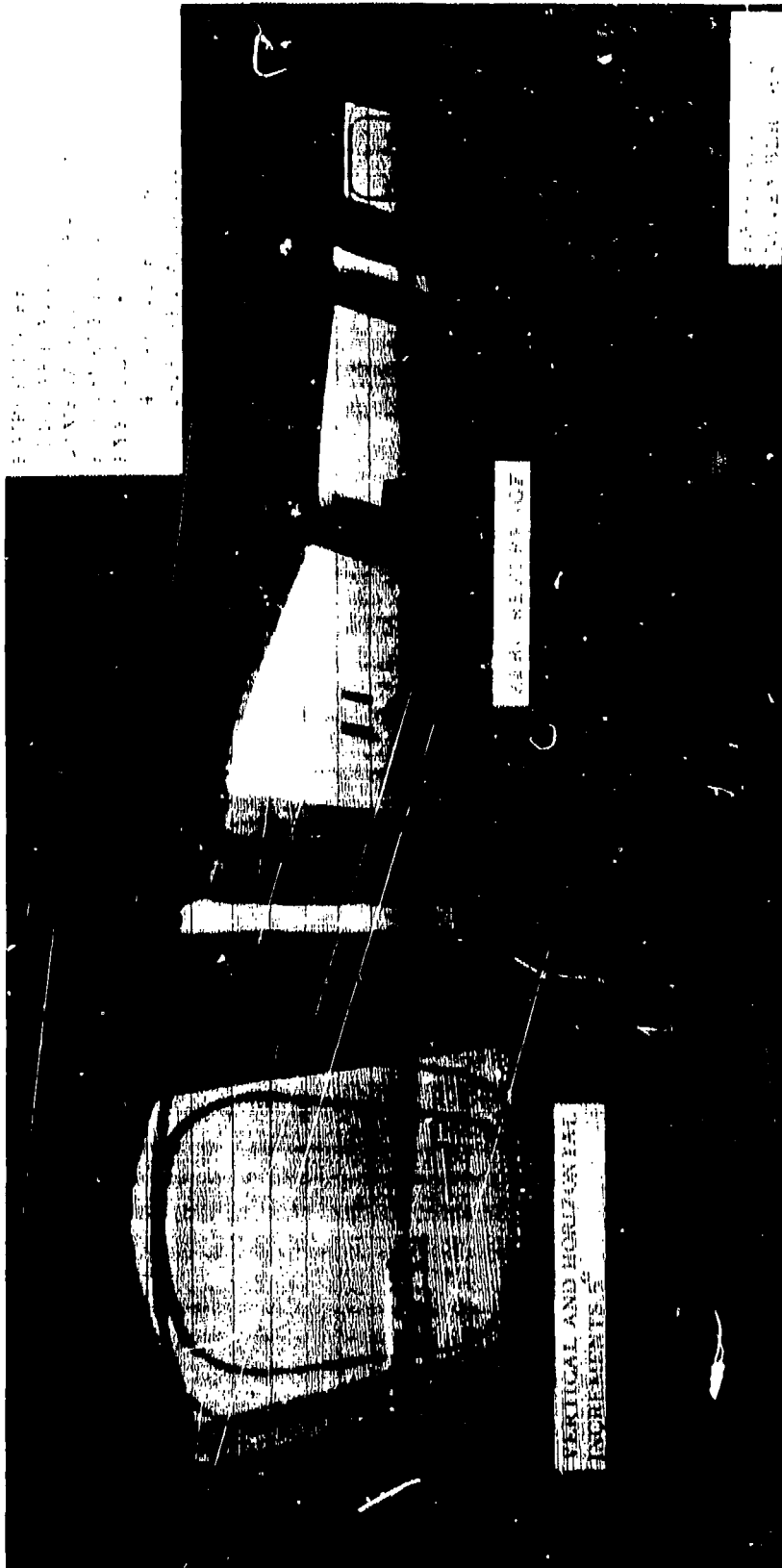


FIGURE 32. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT FAIRCHILD FH-227

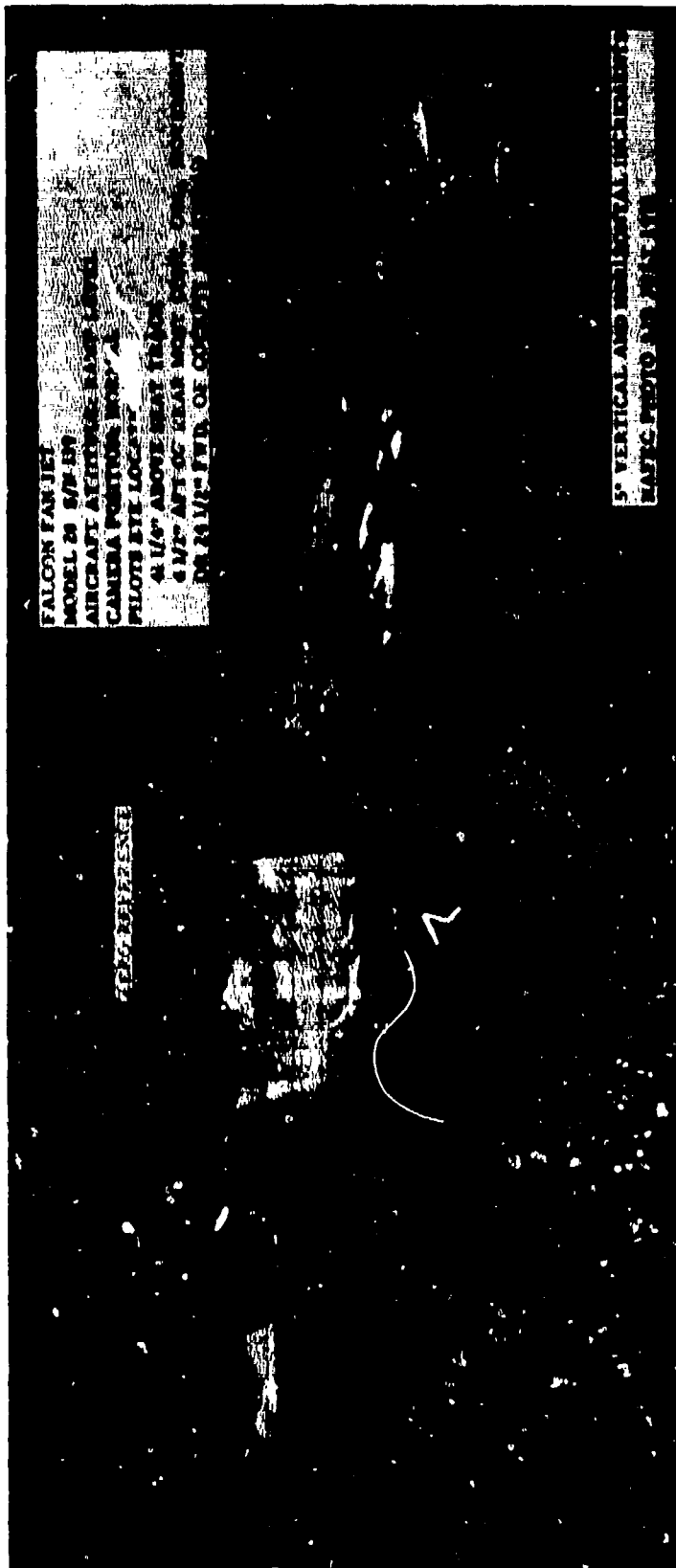


FIGURE 33. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT FALCON FAN JET 20



FIGURE 34. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT LEAR JET MODEL 24

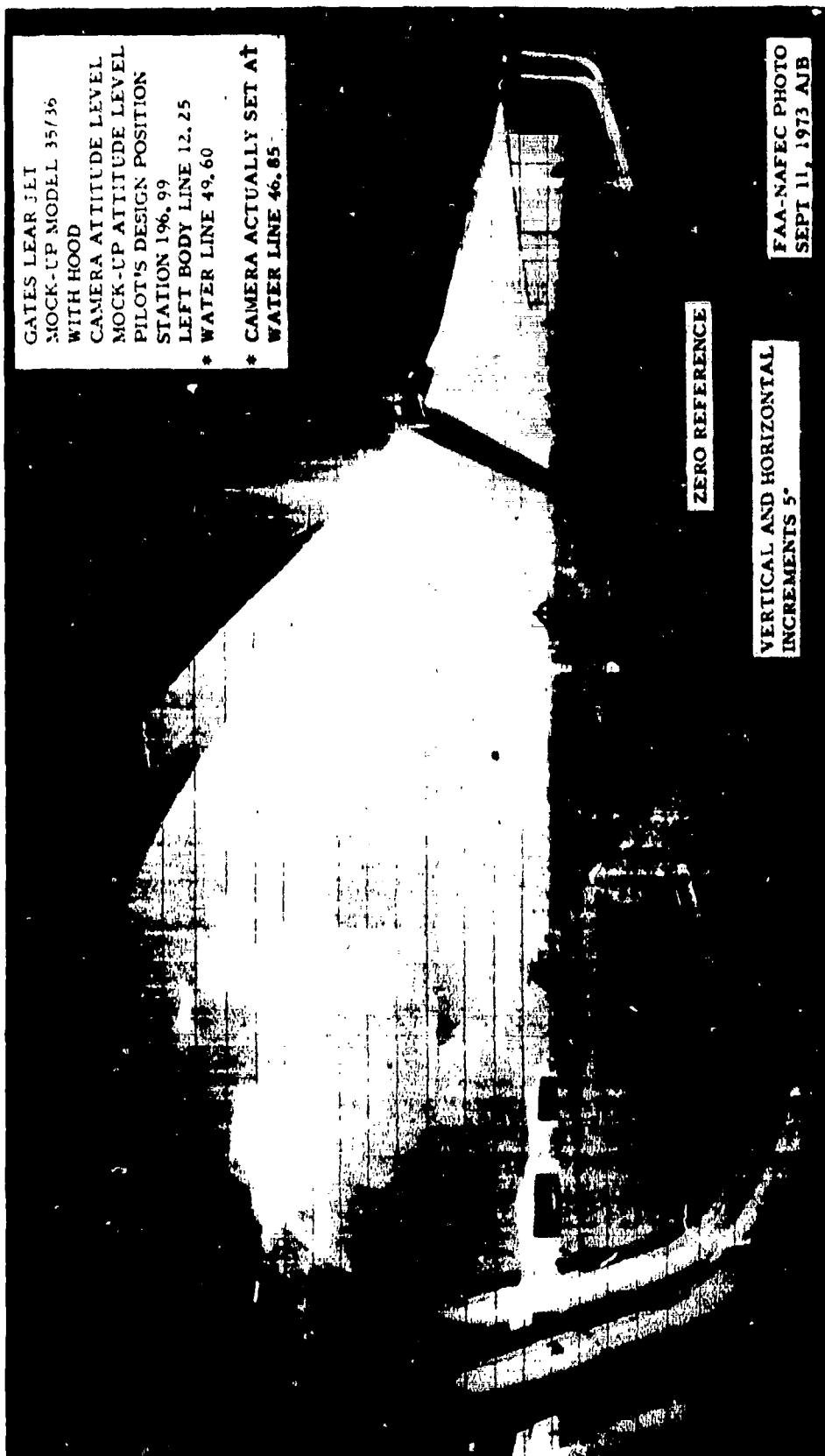


FIGURE 35. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT GATES LEAR JET MODEL 35/36

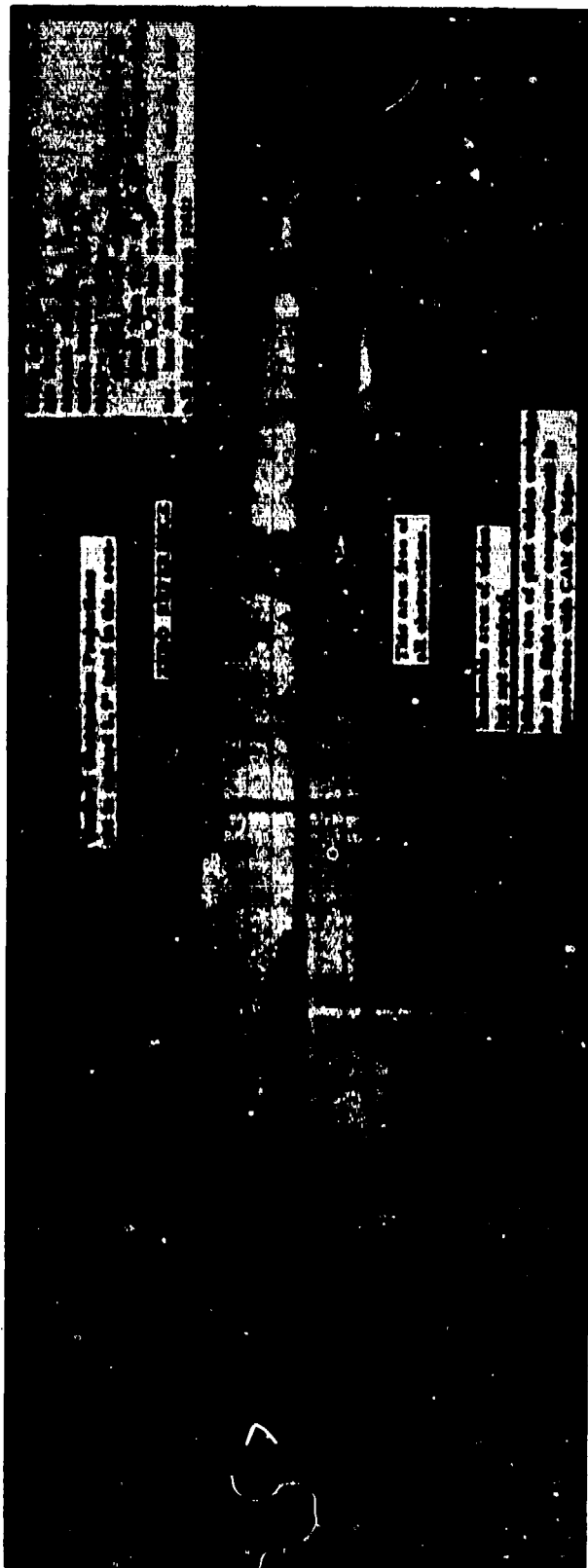


FIGURE 36. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT GATES LEAR JET MODEL 55

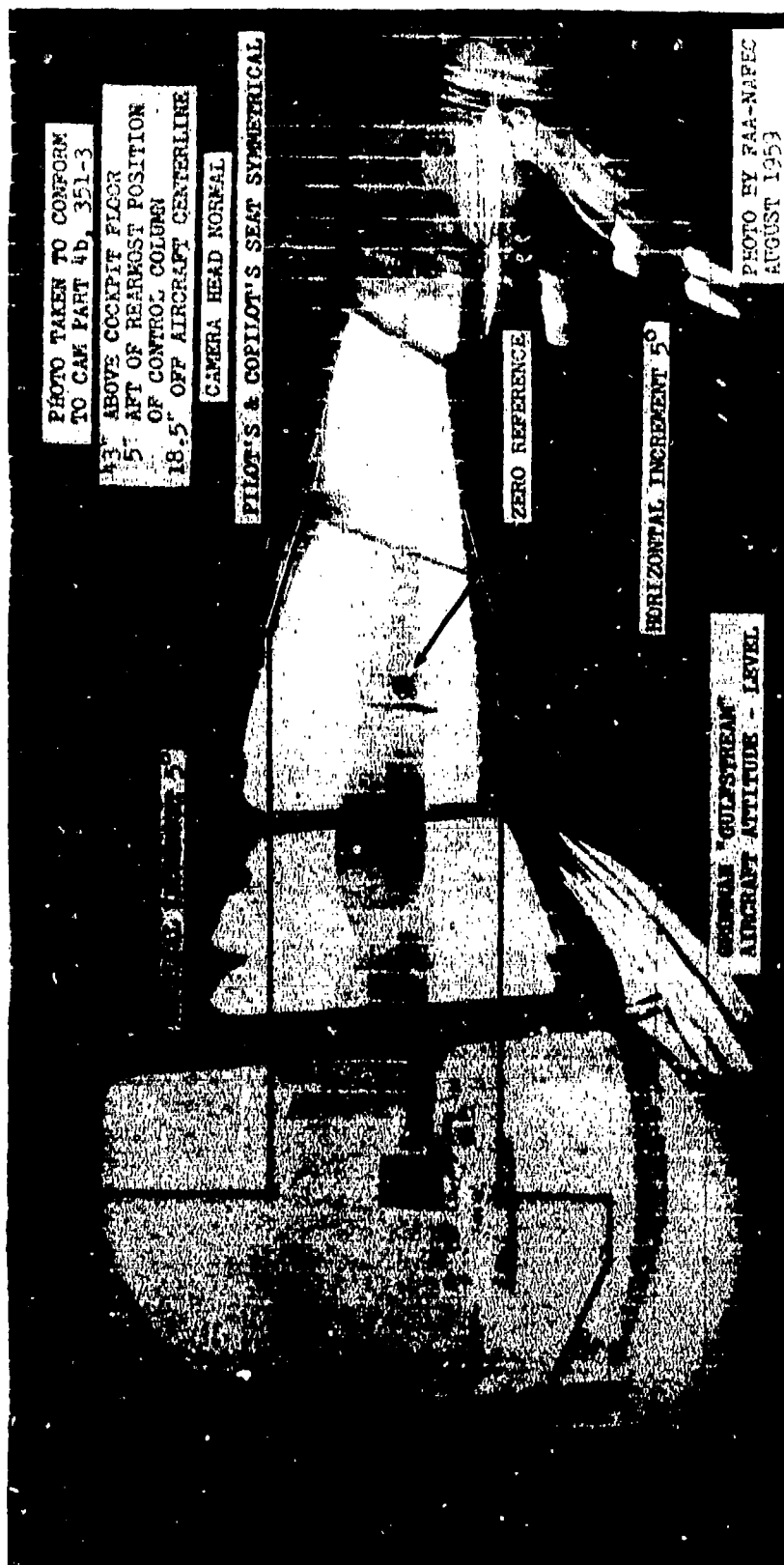


FIGURE 37. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT GRUMMAN GULFSTREAM

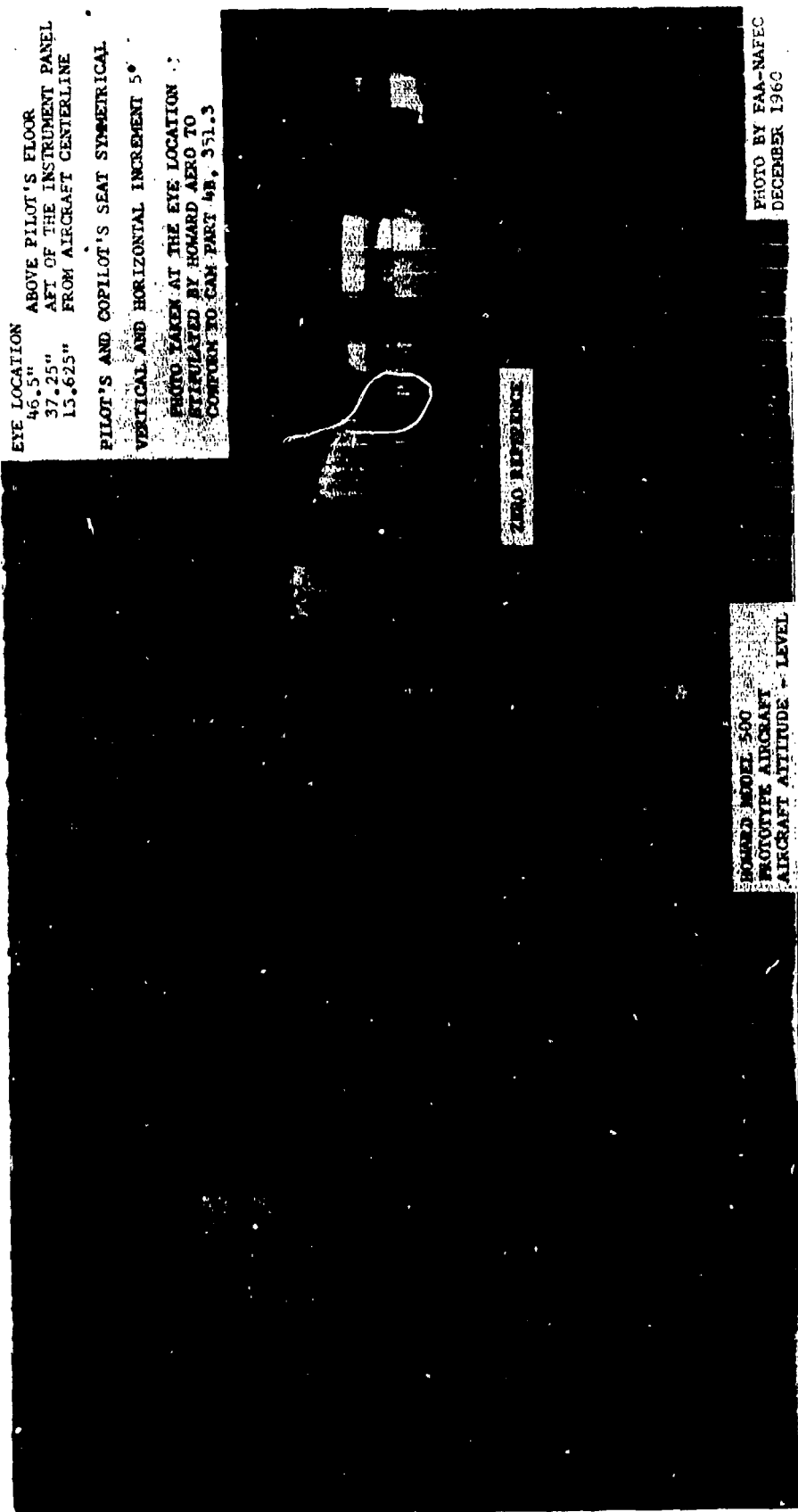


FIGURE 38. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT HOWARD MODEL 500

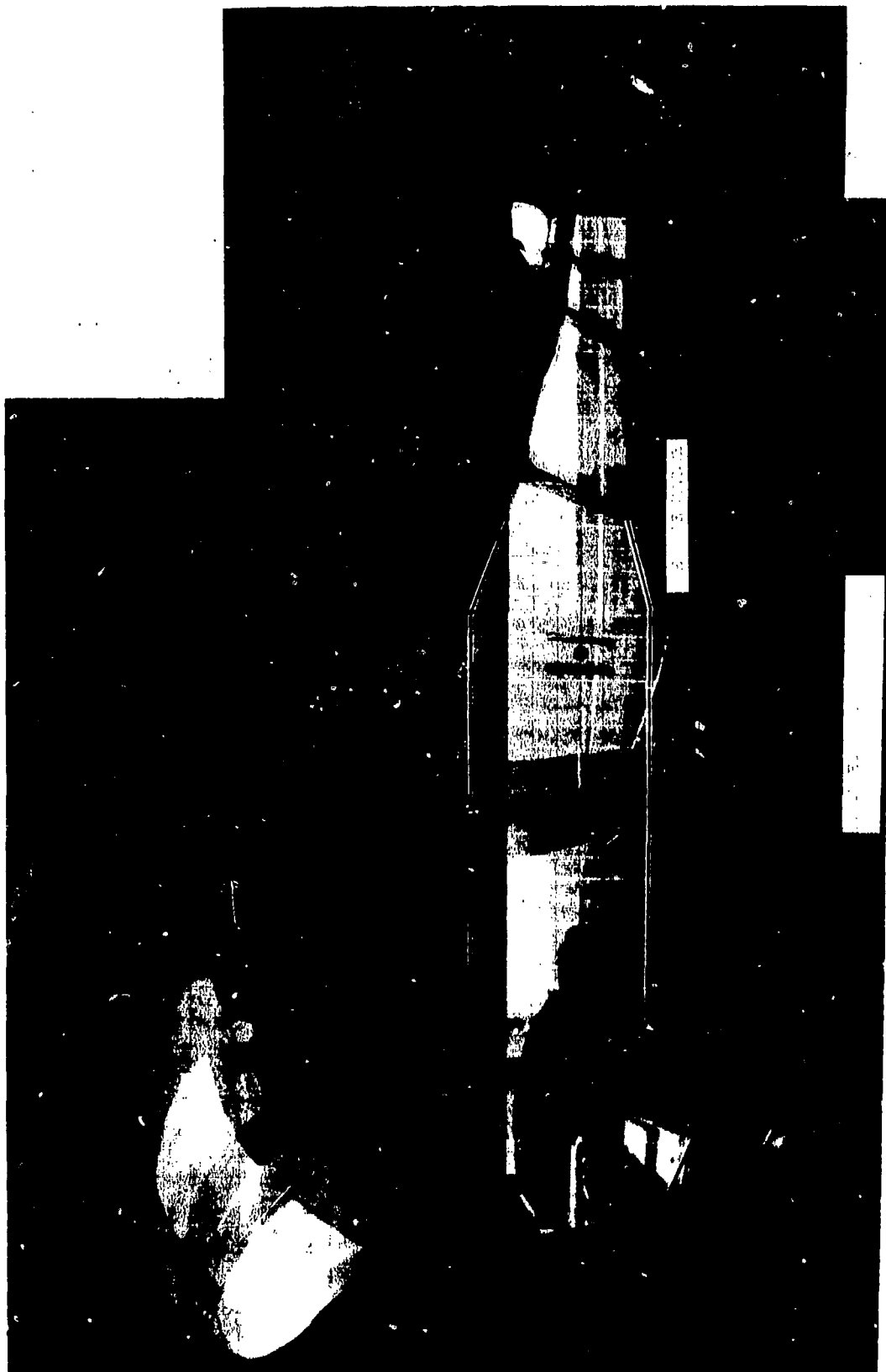


FIGURE 39. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT LOCKHEED ELECTRA



FIGURE 40. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT LOCKHEED 1329

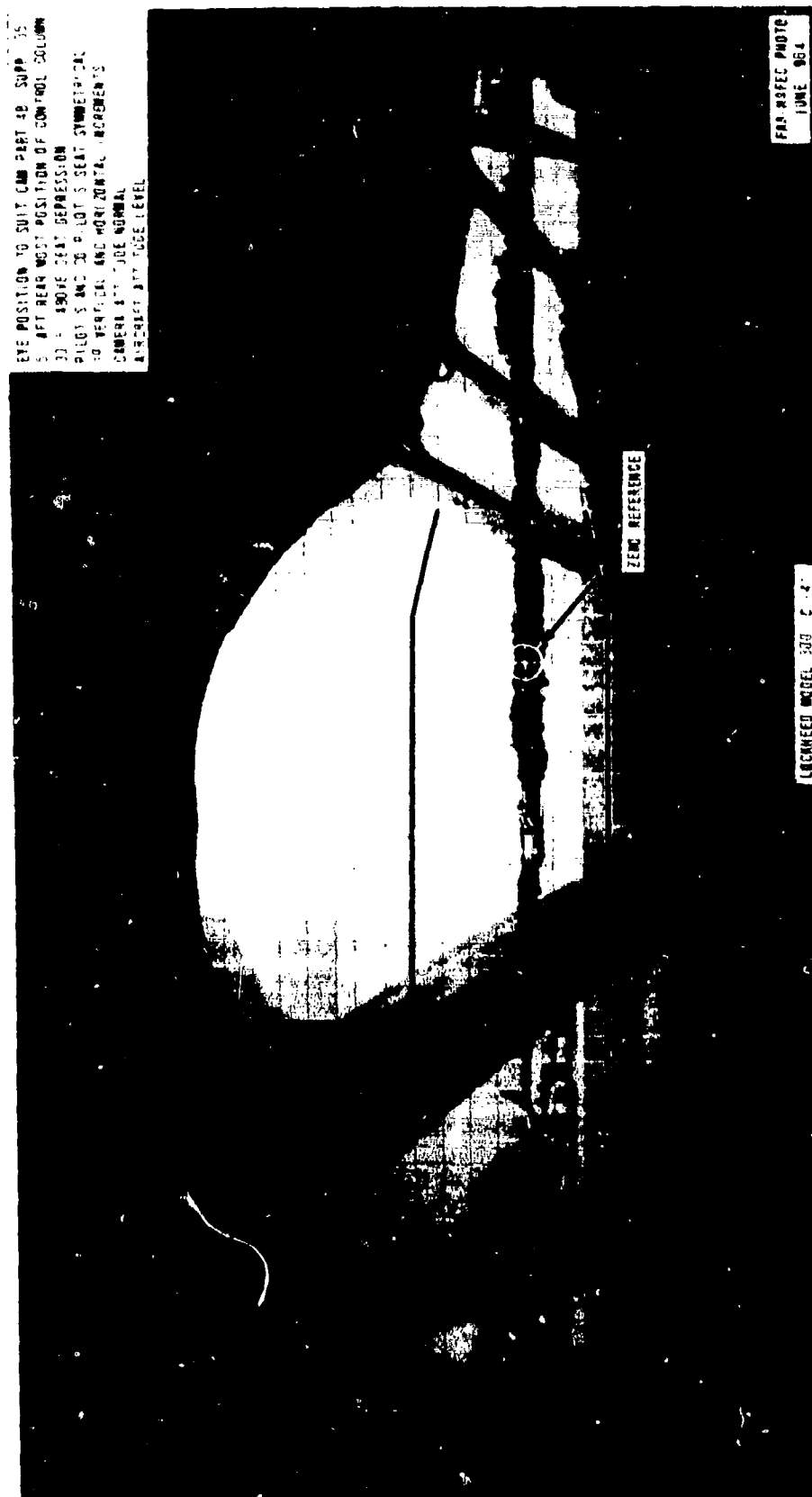


FIGURE 41. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT LOCKHEED MODEL 300

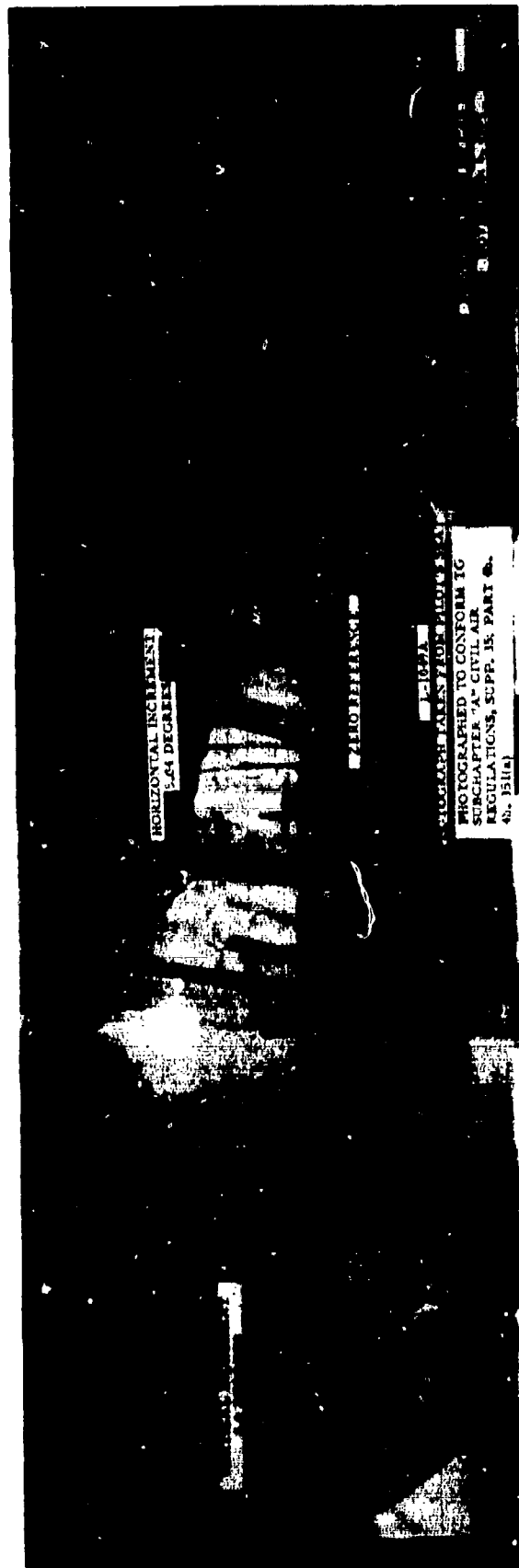


FIGURE 42. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT LOCKHEED L-1049A

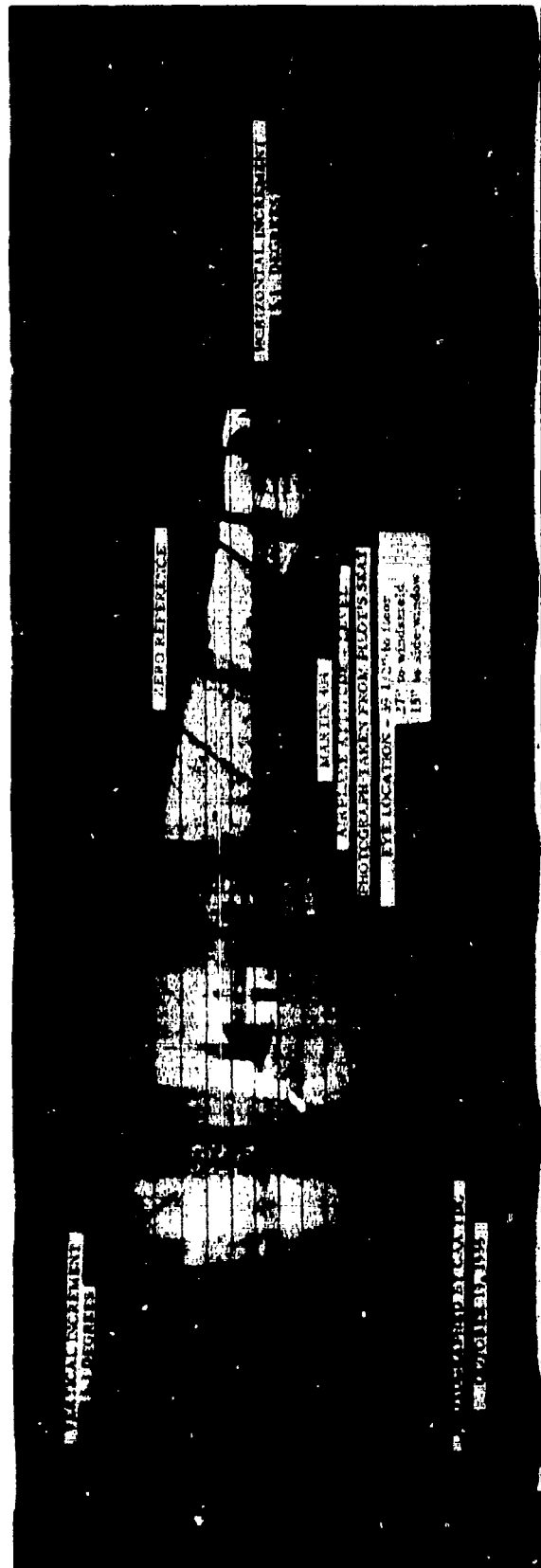
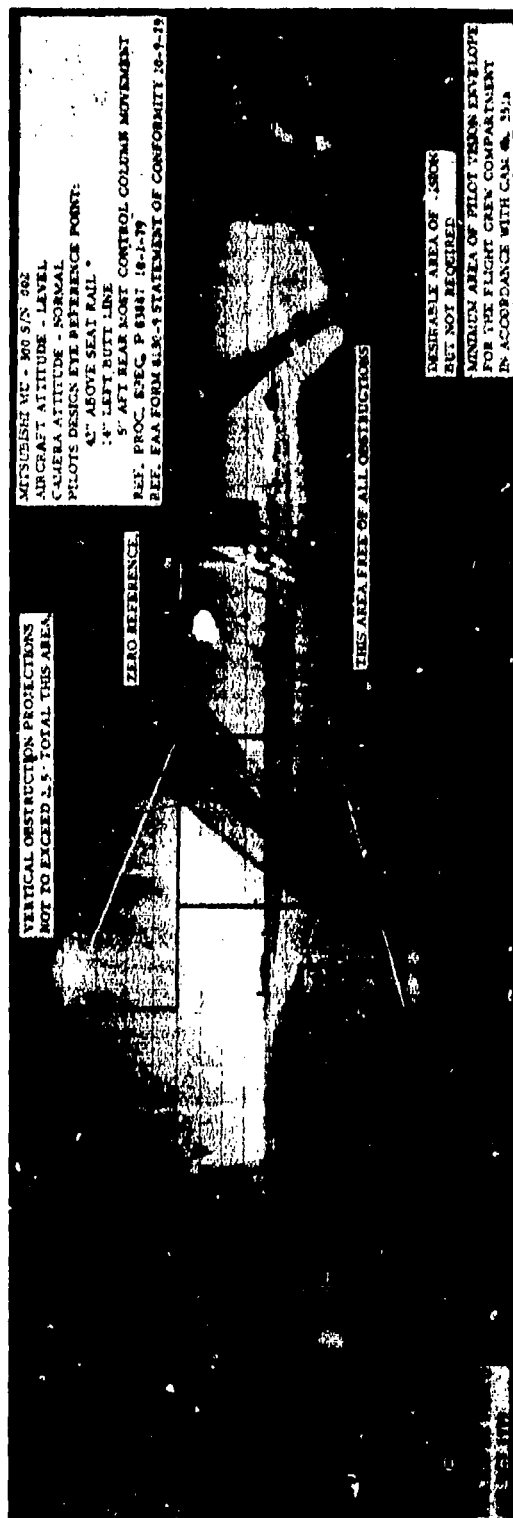
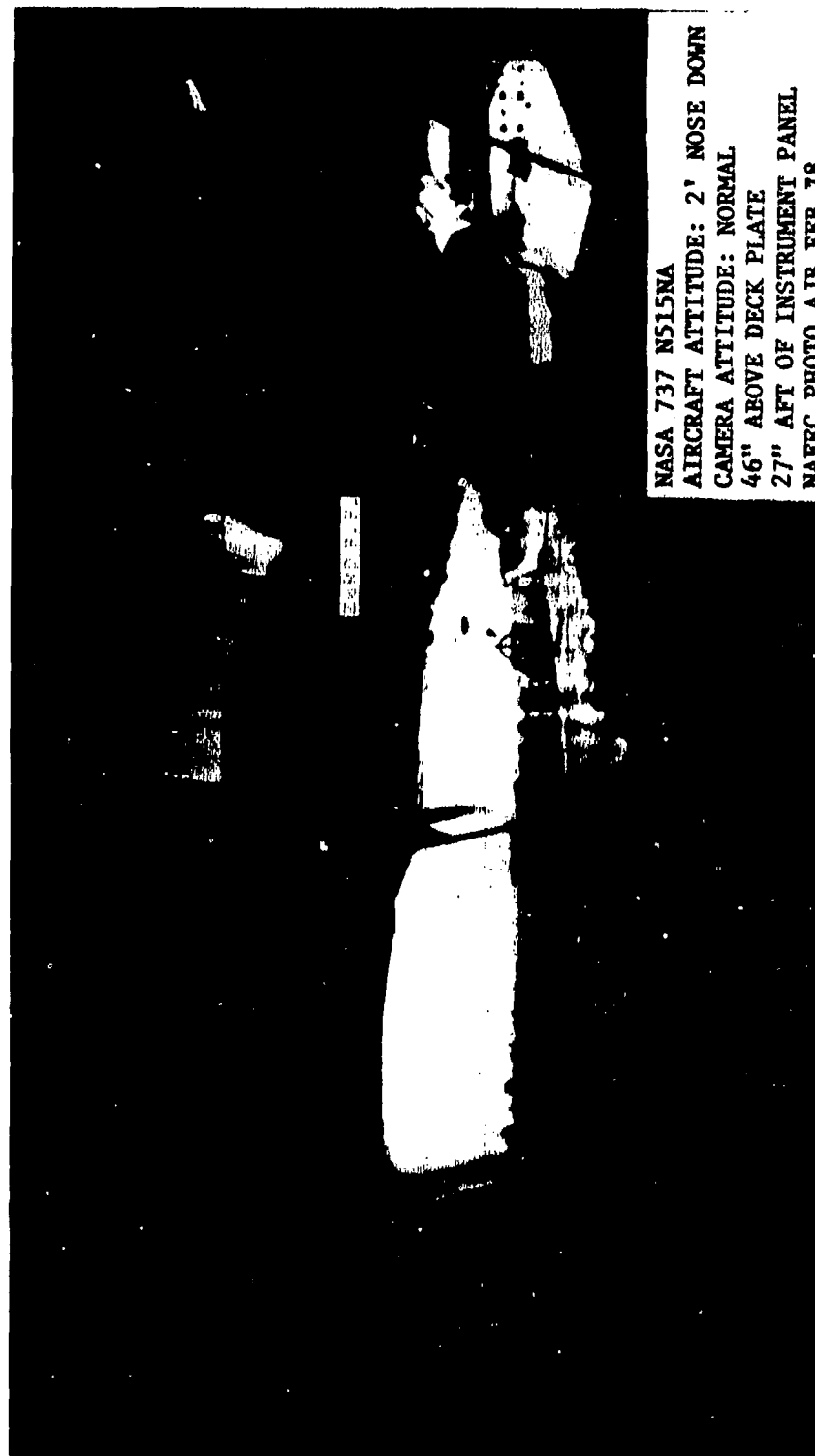


FIGURE 43. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT MARTIN MODEL 404



NOTE: This cockpit not in final form, glare shield and other features to improve visibility to be made.

FIGURE 44. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT MITSUBISHI MU-300



NASA 737 N515NA
AIRCRAFT ATTITUDE: 2' NOSE DOWN
CAMERA ATTITUDE: NORMAL
46" ABOVE DECK PLATE
27" AFT OF INSTRUMENT PANEL
NAFEC PHOTO AJB FEB 78

FIGURE 45. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT NASA/BOEING-737

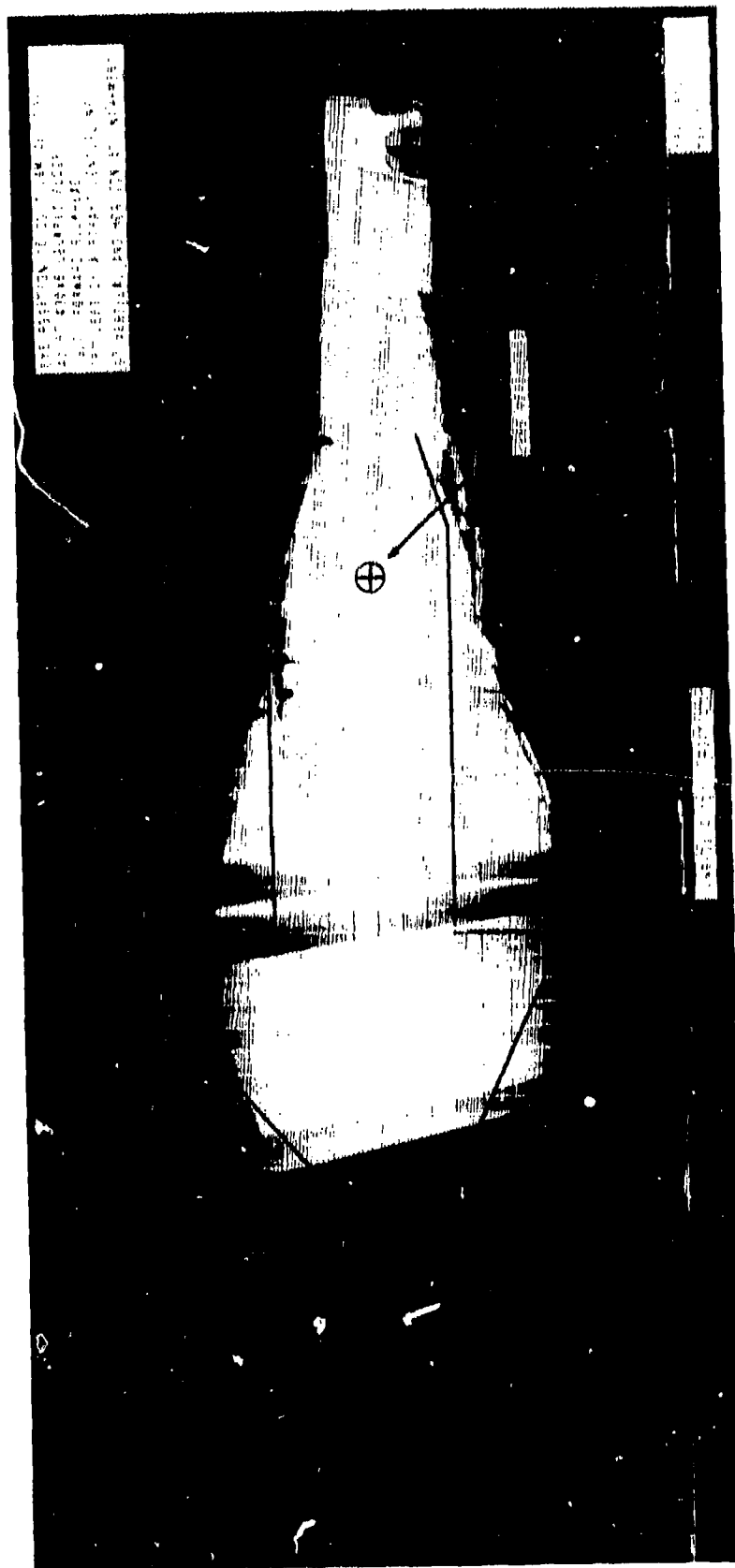


FIGURE 46. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SUNRISE S-1600

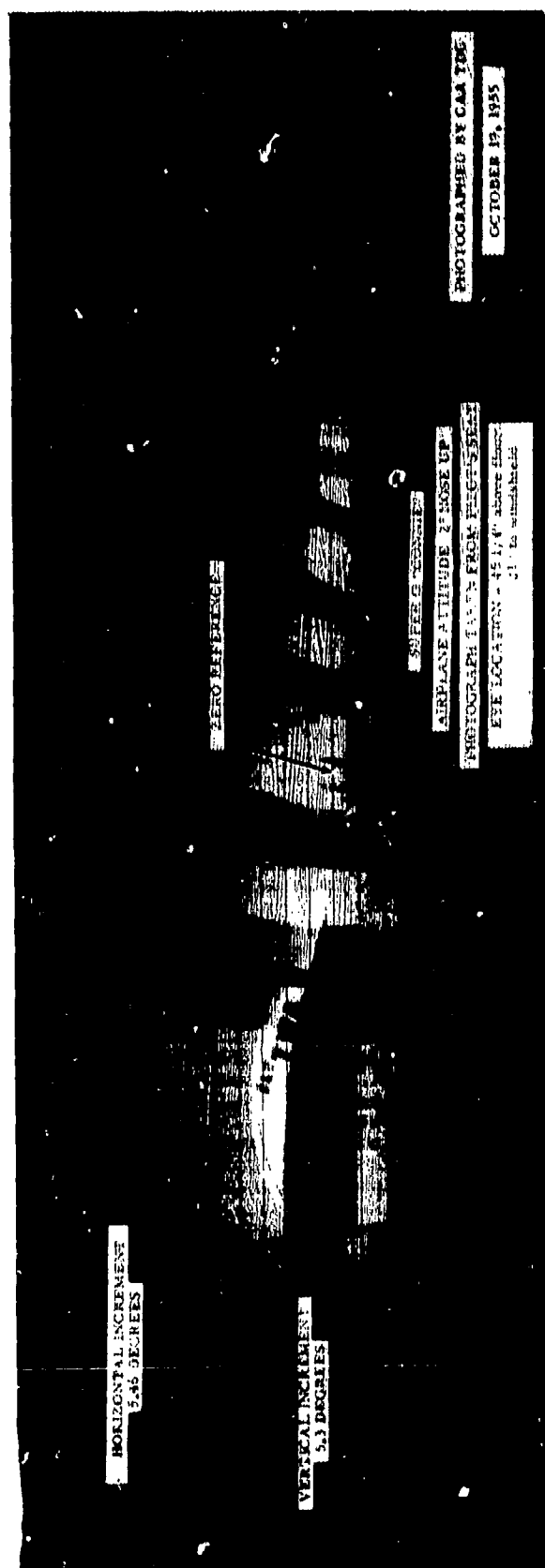


FIGURE 47. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SUPER G CONSTELLATION

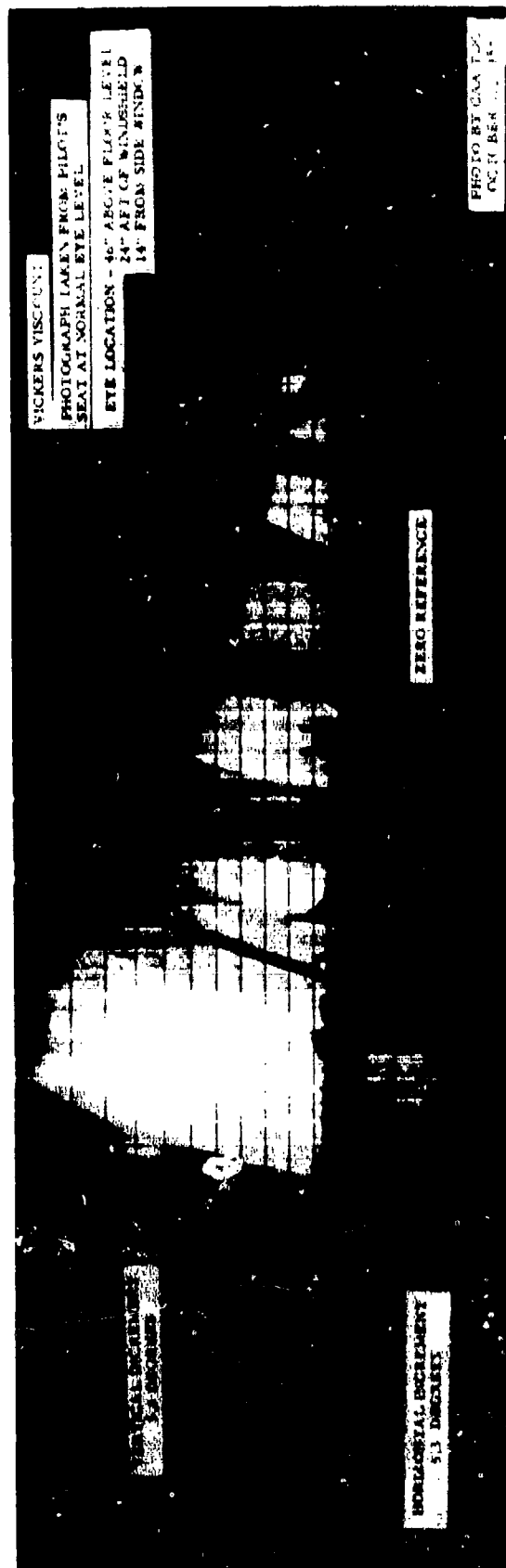


FIGURE 48. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT VICKERS VISCOUNT

CIVILIAN AIRCRAFT
12,500 pounds or less

The aircraft in the following listing are depicted in figures 49 through 74.

Aero 680E

Beech 55
Beech 99

Cessna 140A
Cessna 150F
Cessna 170
Cessna 172
Cessna 177
Cessna 180
Cessna 182
Cessna 206
Cessna 210
Cessna 310
Cessna 337B

DeHavilland DHC-6
Helio Plane
Helio Model 500

Mooney 21

Piper Arrow PA-28R-200
Piper Aztec PA-23
Piper Cherokee Archer PA-28-181
Piper Cherokee 140 PA-28-180
Piper Cherokee 140
Piper Cherokee 6 PA-32-260
Piper Navajo PA-31

Swift 125



FIGURE 49. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AERO COMMANDER 680E

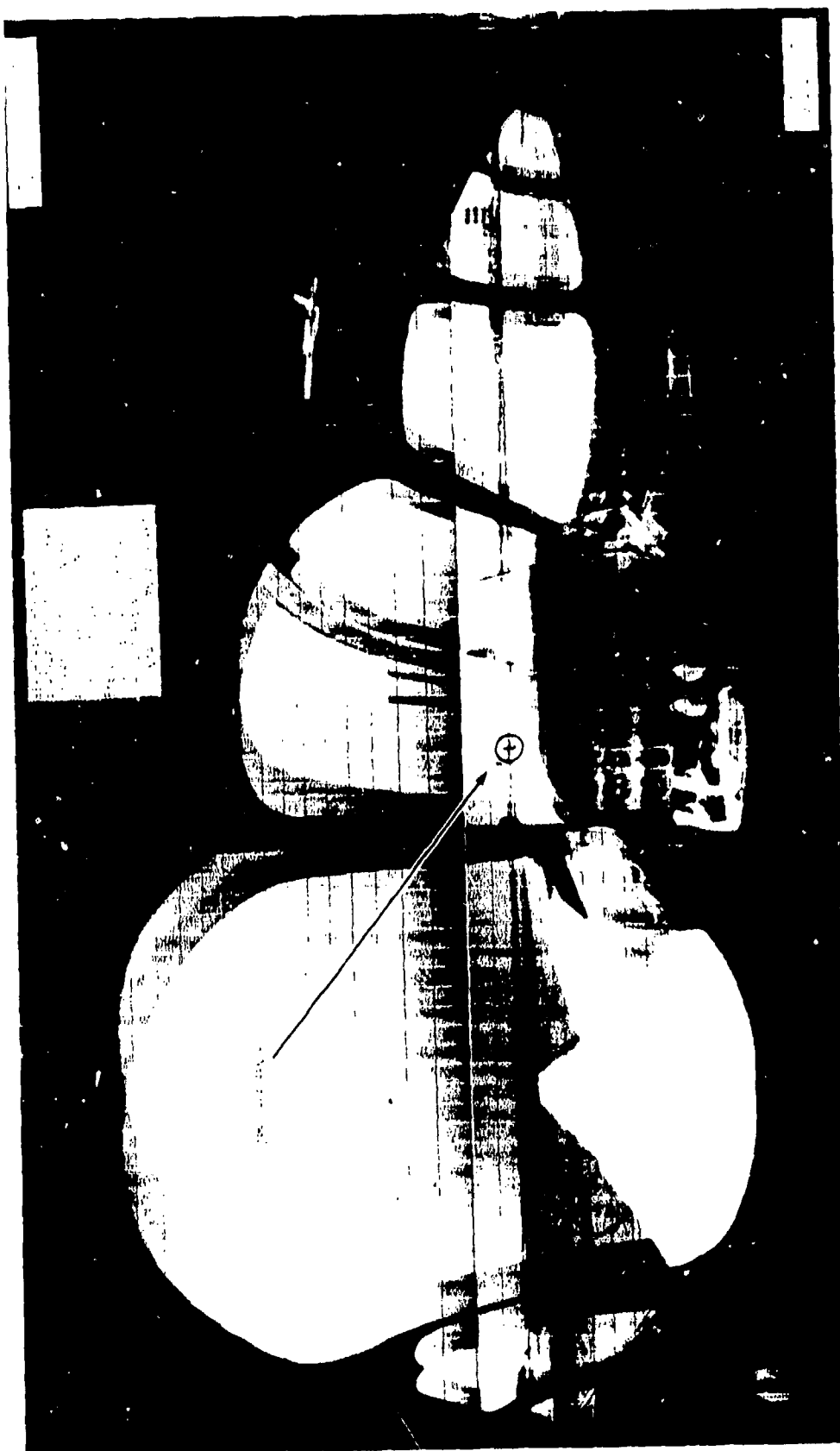


FIGURE 50. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BEECHCRAFT BARON B-55

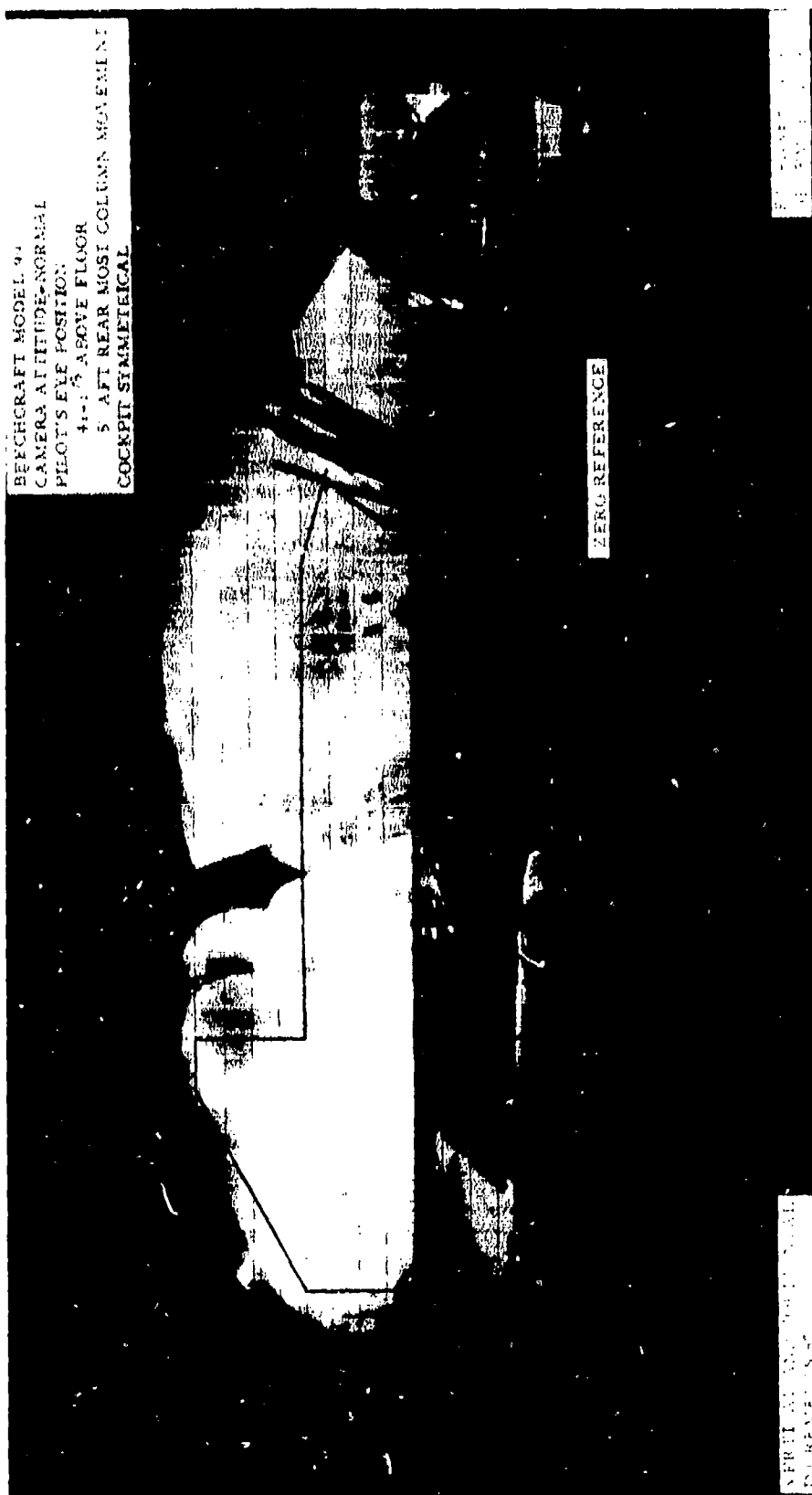


FIGURE 51. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BEECHCRAFT MODEL 99

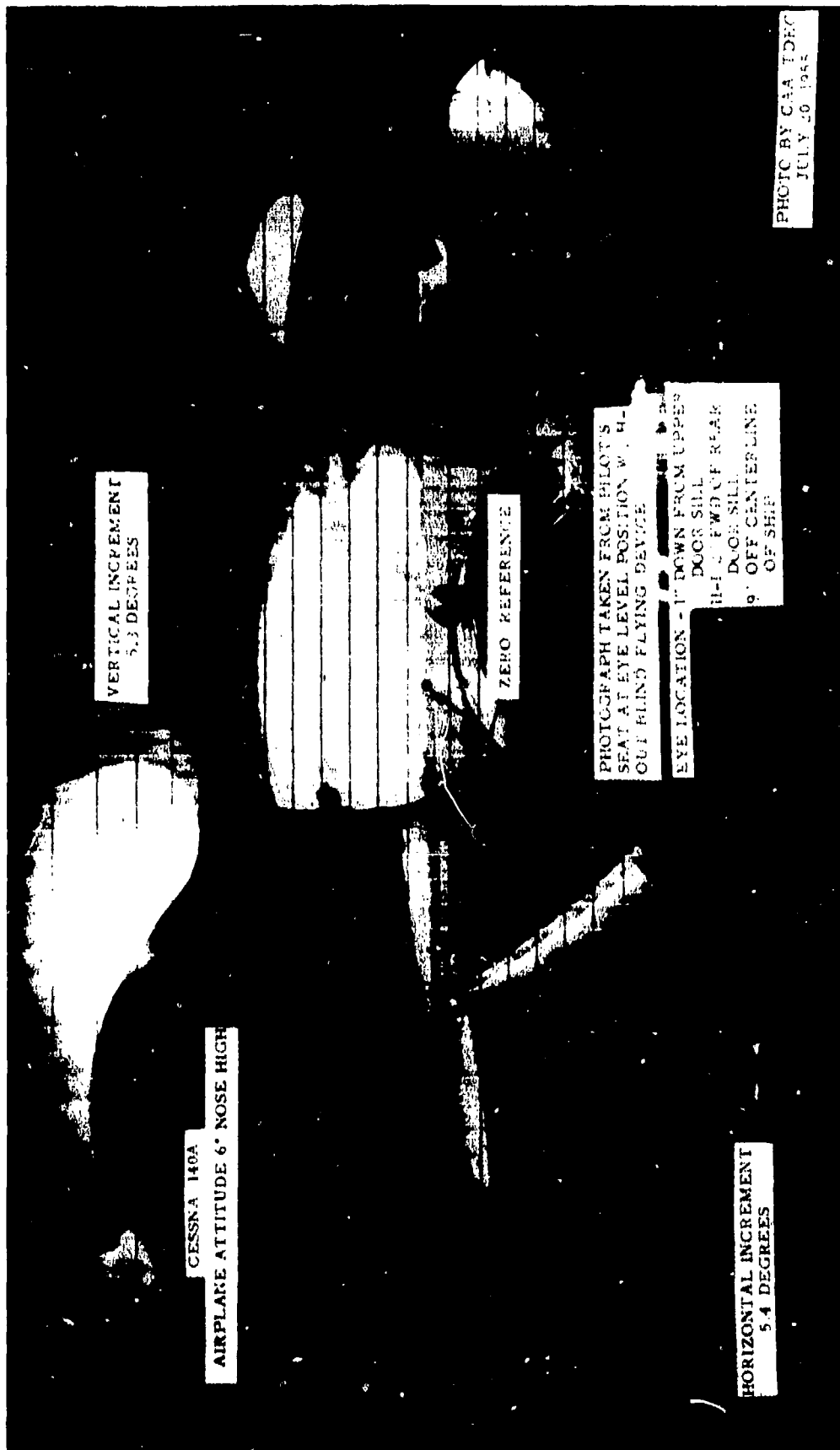


FIGURE 52. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 140A

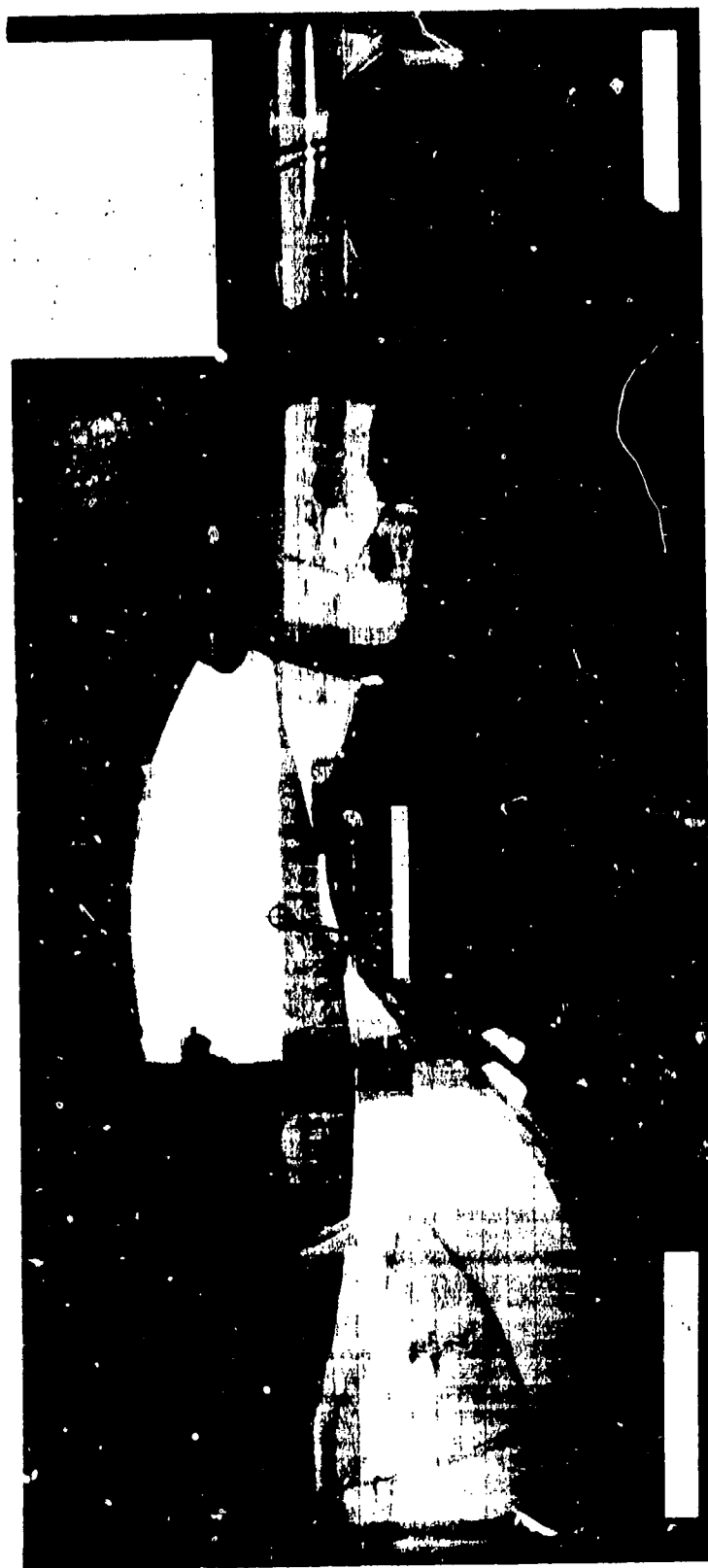


FIGURE 53. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 150F



FIGURE 54. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 170

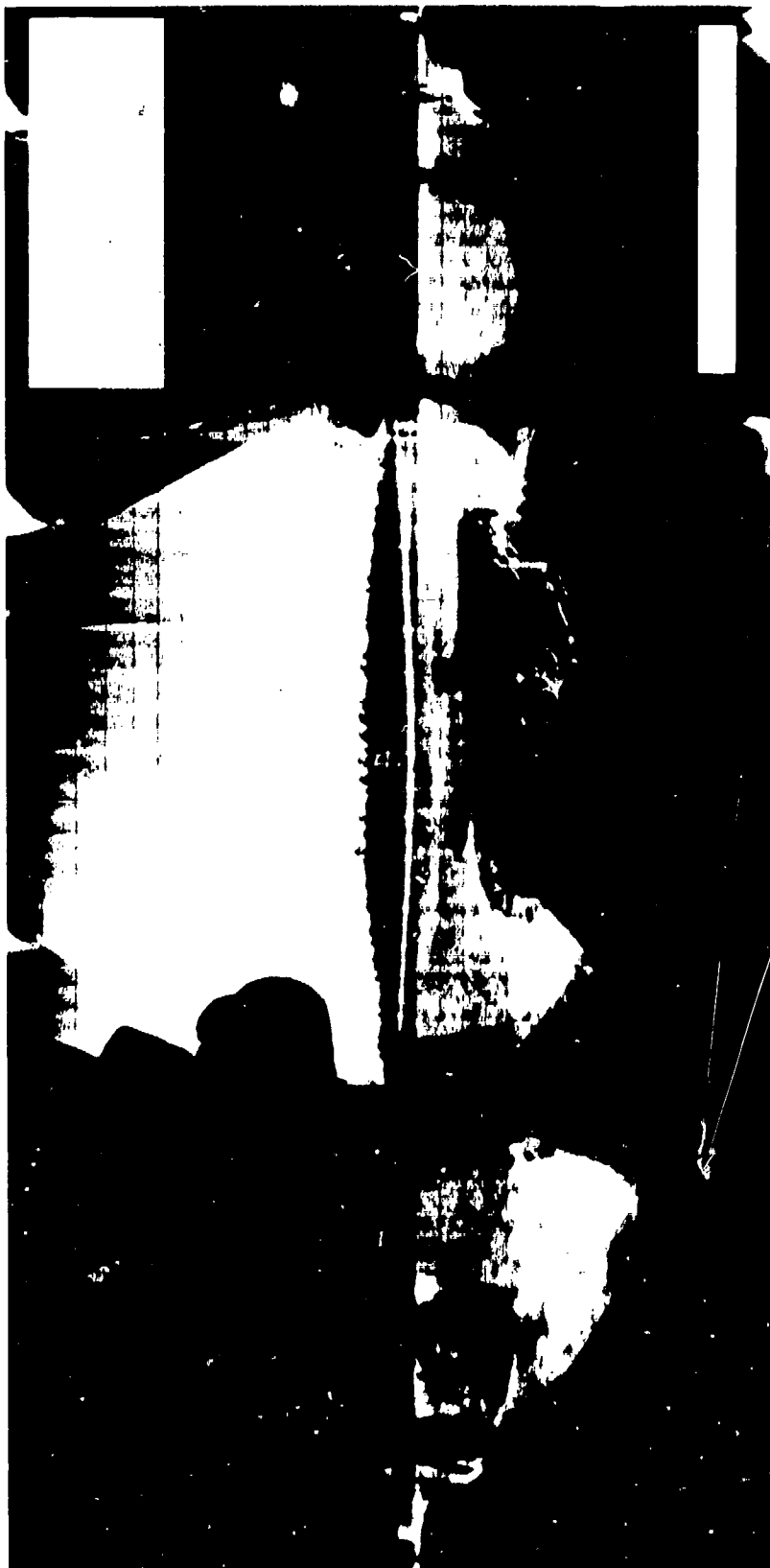


FIGURE 55. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 172



FIGURE 56. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 177

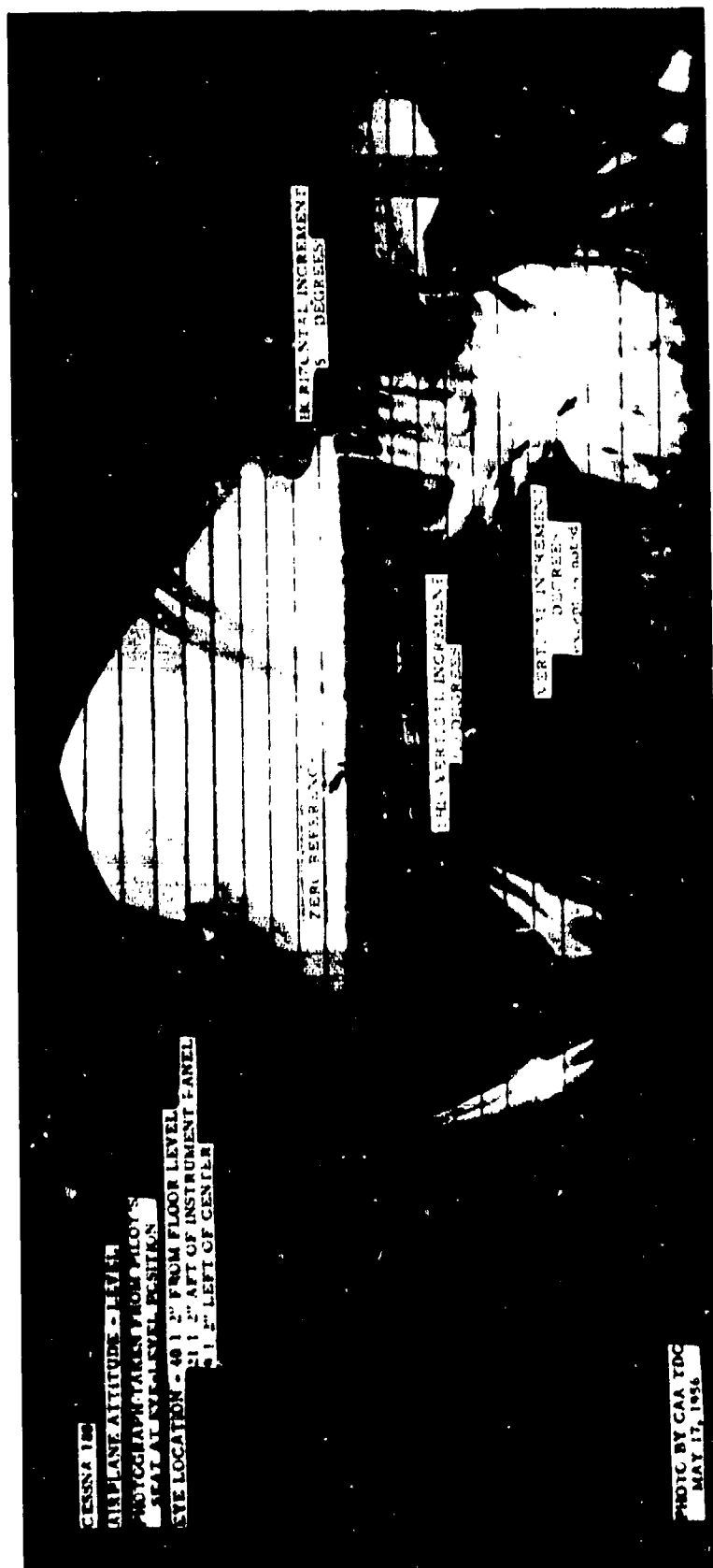


FIGURE 57. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 180



FIGURE 58. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 182

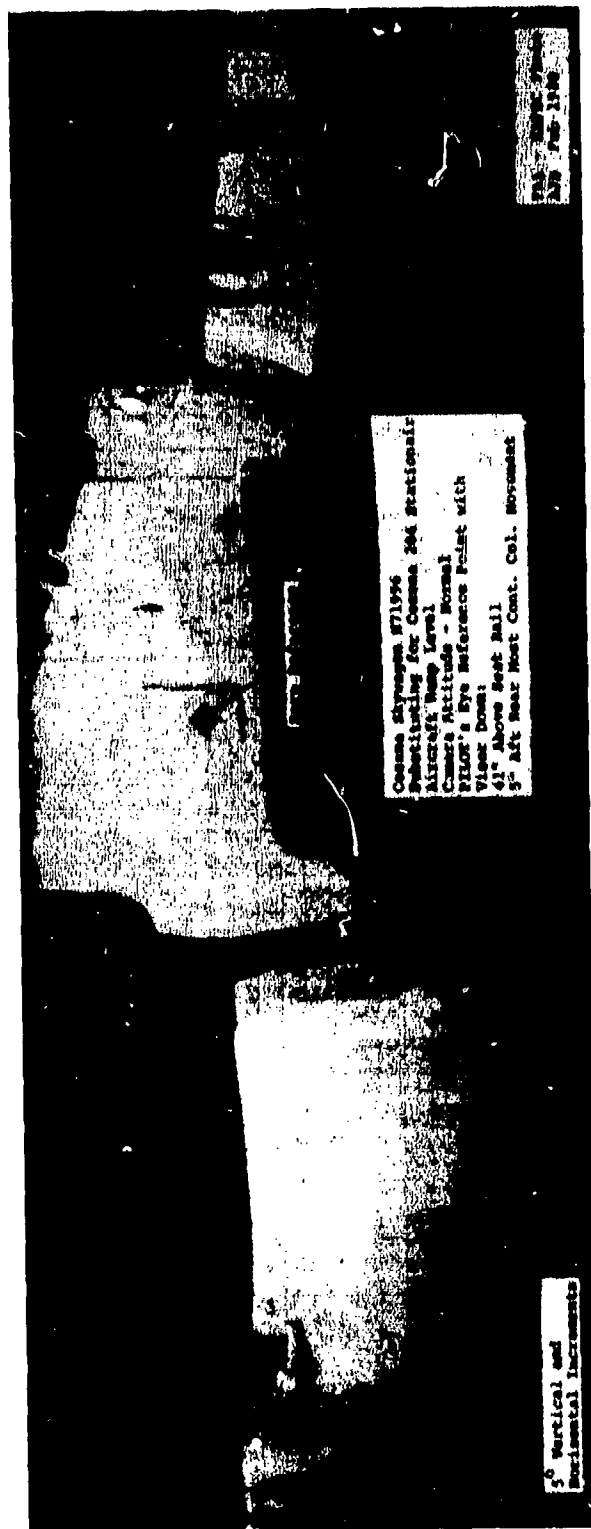


FIGURE 59. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA SKYWAGON



FIGURE 60. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 210

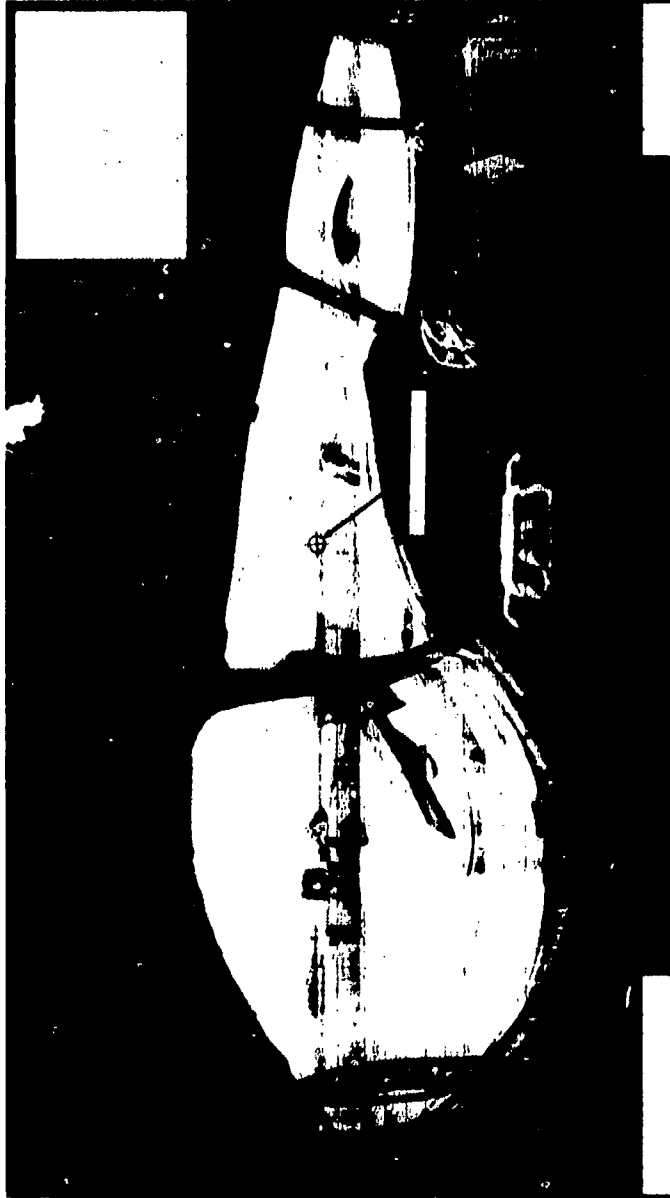


FIGURE 61. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 310

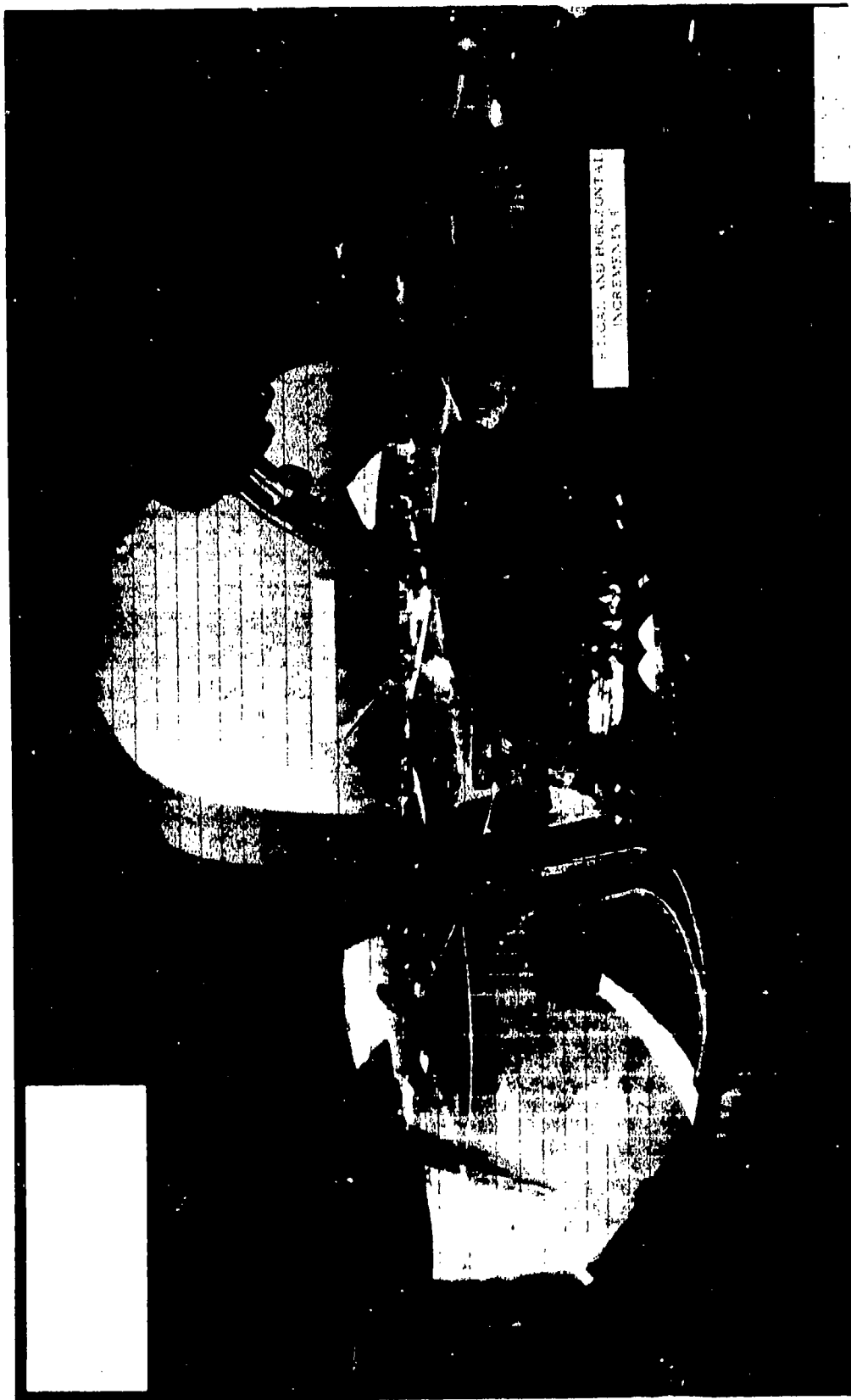


FIGURE 62. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA 337B

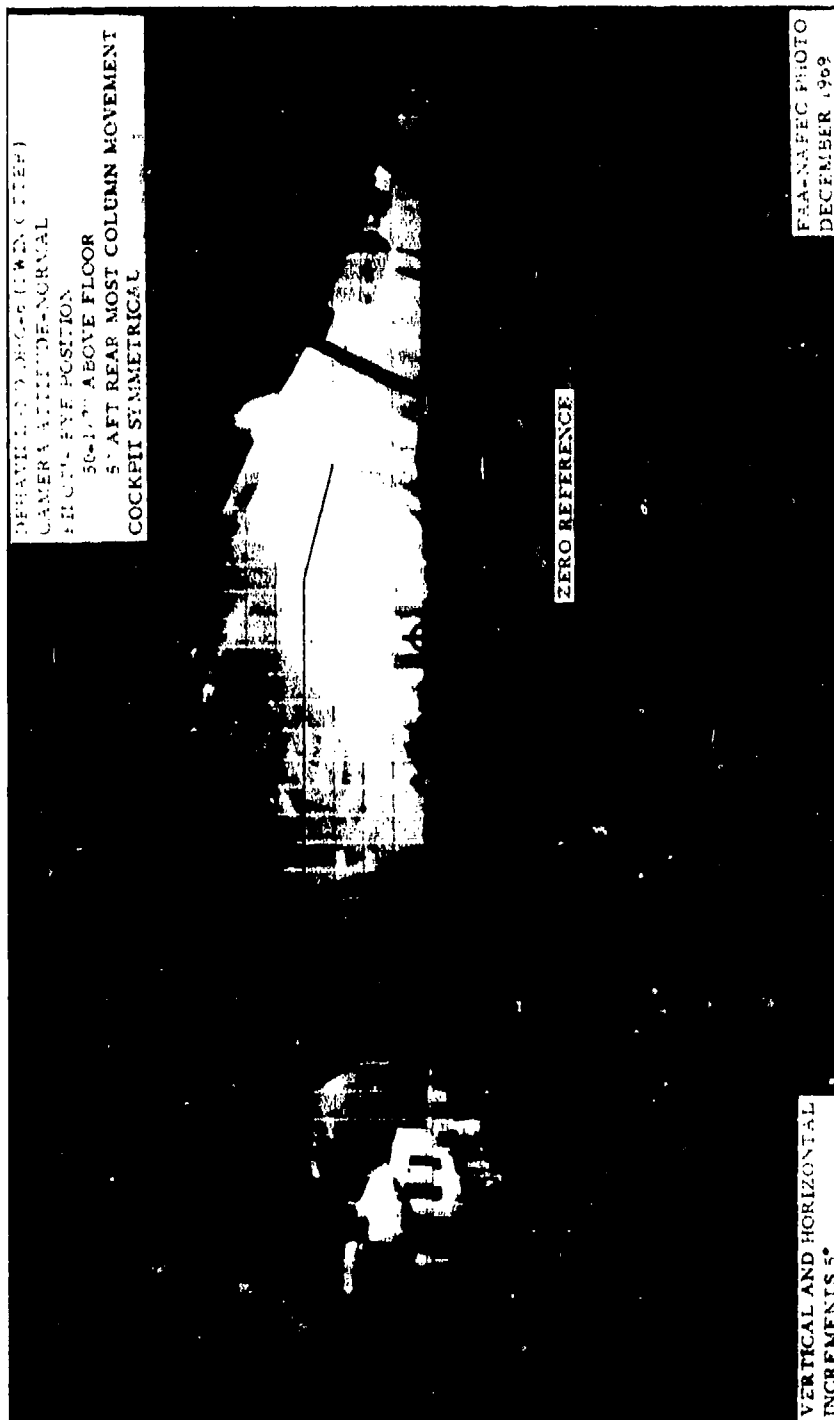


FIGURE 63. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DEHAVILLAND DHC-6

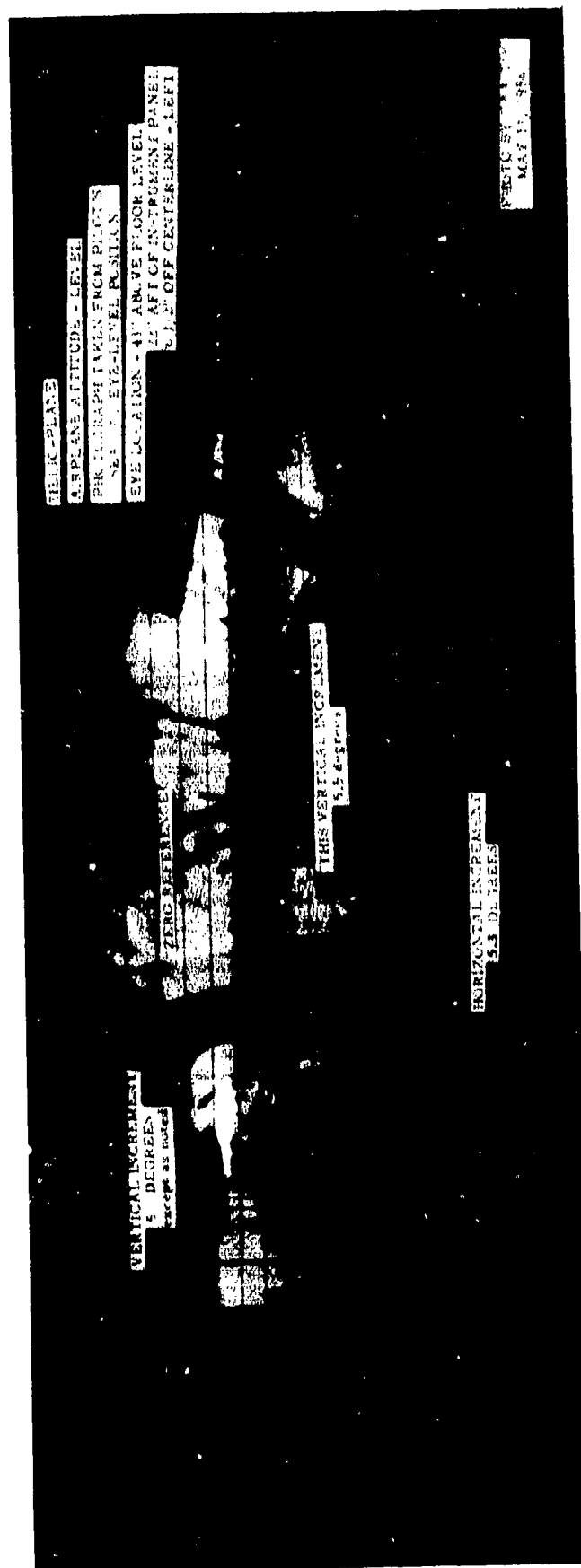


FIGURE 64. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT HELIO-PLANE

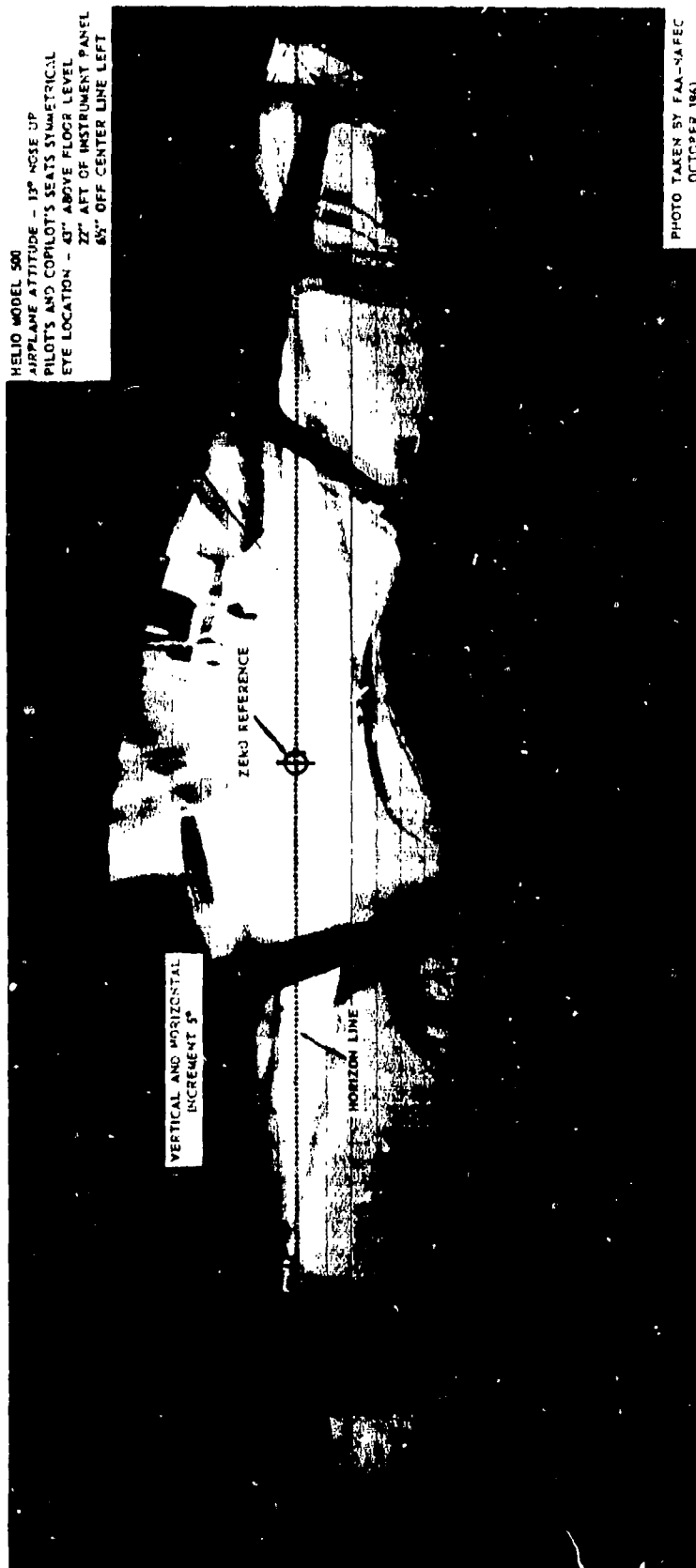


FIGURE 65. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT HELIO MODEL 500

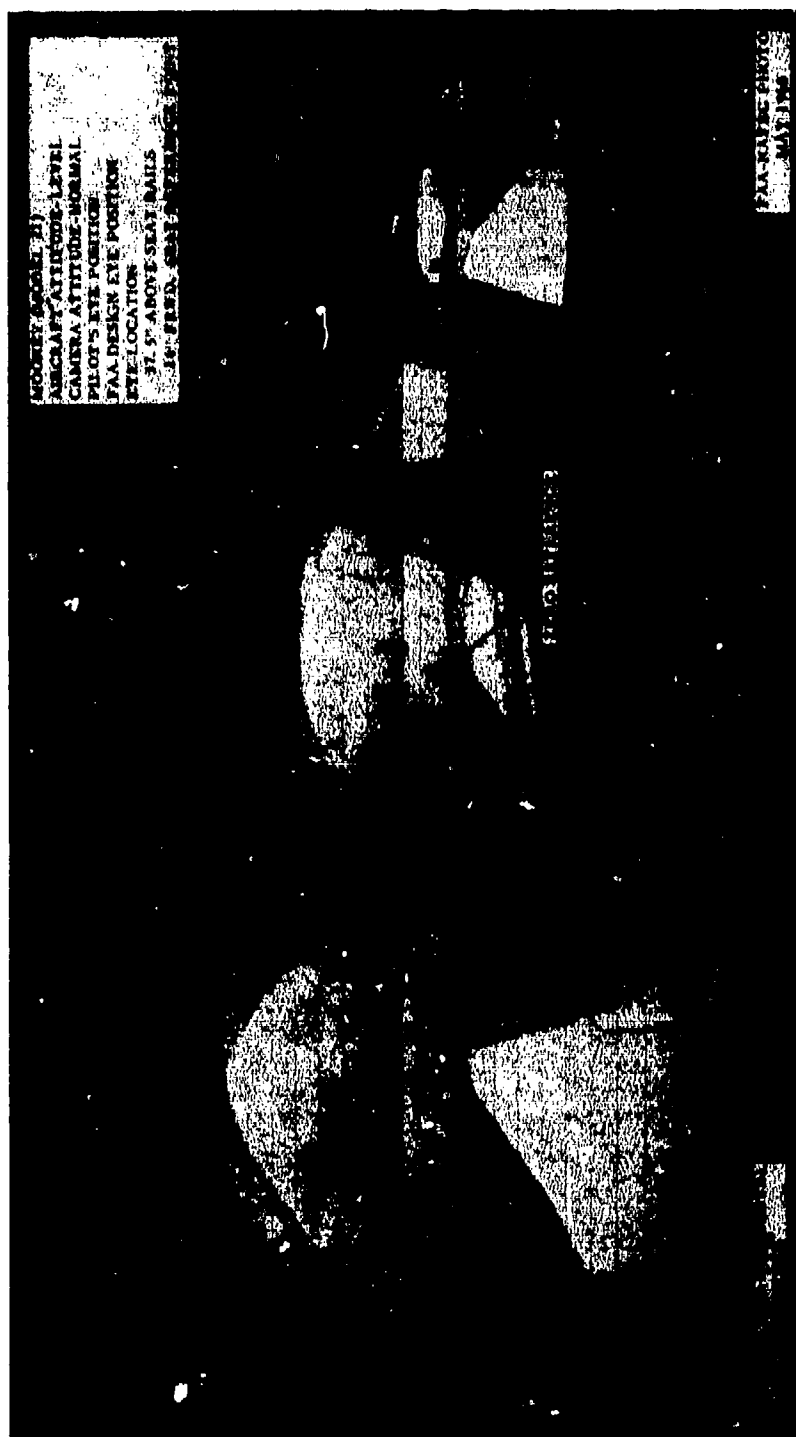


FIGURE 66. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT MOONEY 21



FIGURE 67. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT PIPER ARROW PA-28R-200

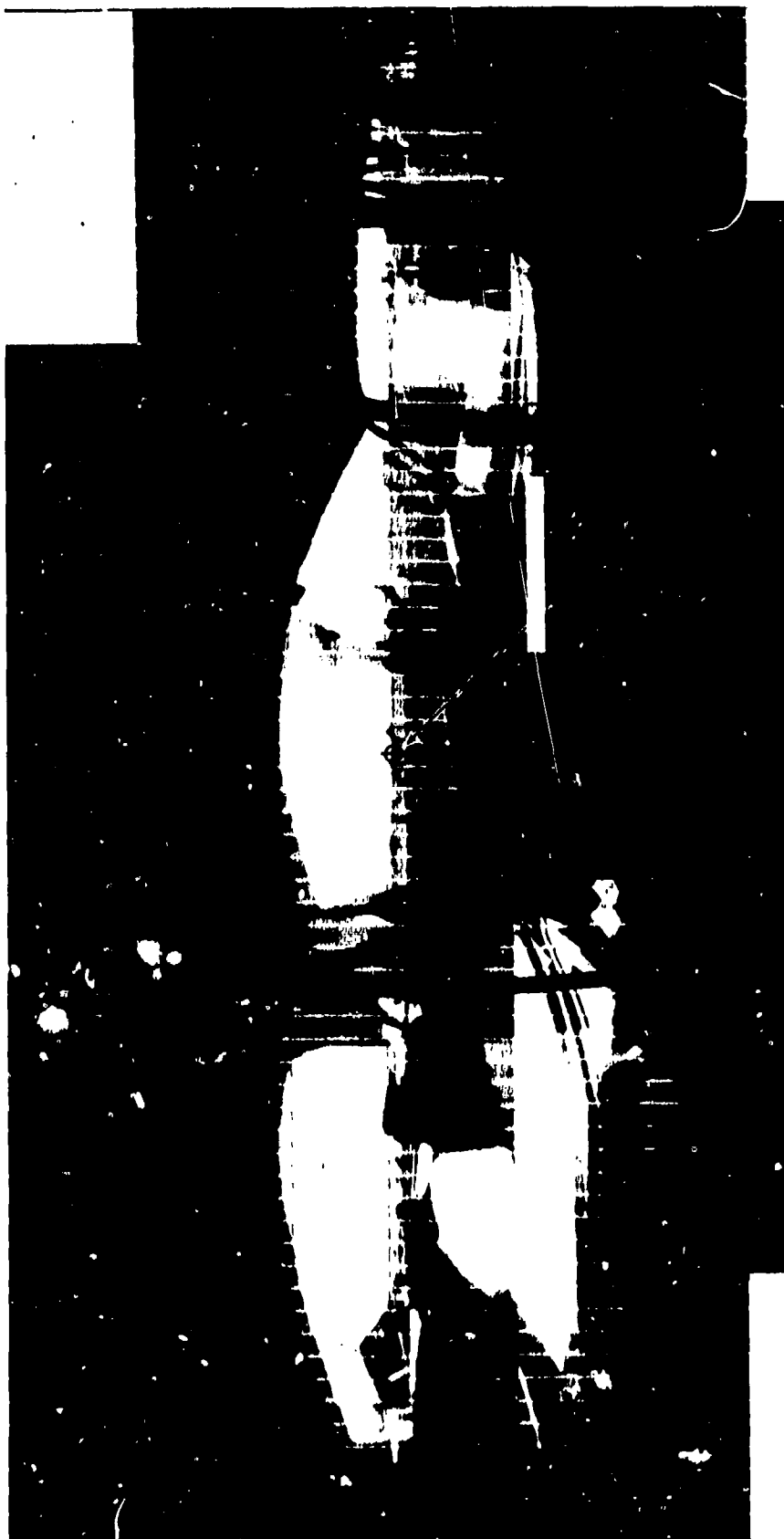


FIGURE 68. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT PIPER AZTEC PA-23



FIGURE 59. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT PIPER CHEROKEE ARCHER PA-28-181

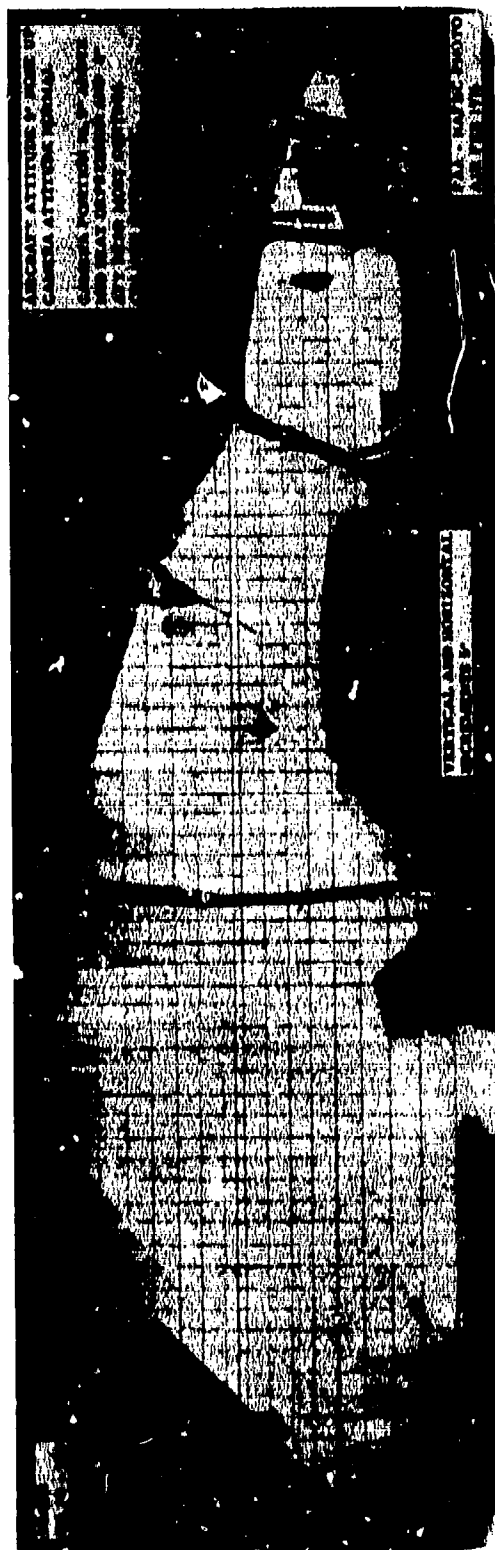


FIGURE 71. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT PIPER CHEROKEE PA-28-180

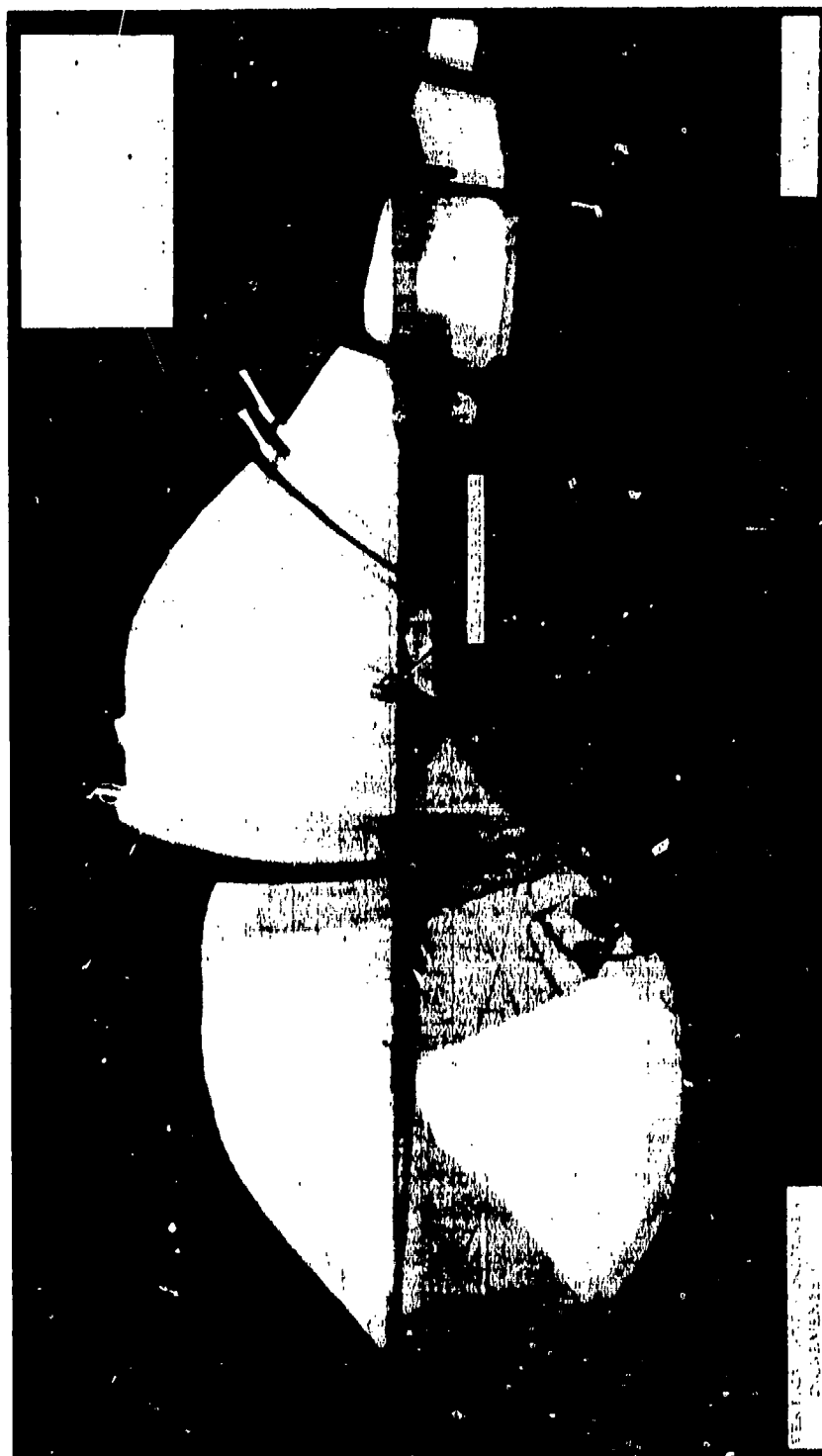


FIGURE 72. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT PIPER CHEROKEE 6 PA-32-260

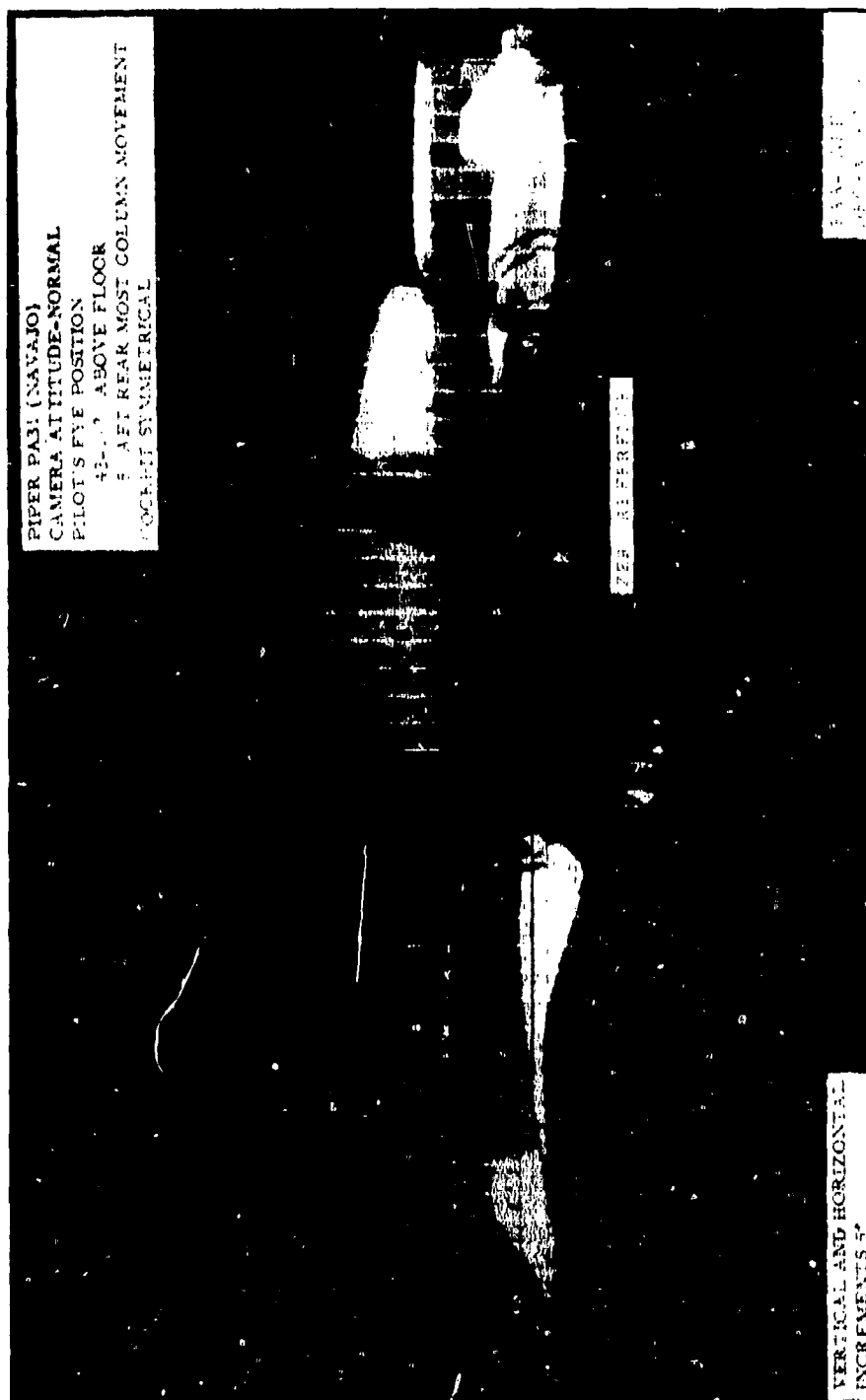


FIGURE 73. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT PIPER NAVAJO PA-31



FIGURE 74. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SWIFT 125

MILITARY AIRCRAFT

HELICOPTERS

The aircraft in the following listing are depicted in figures 75 through 131.

1. B-52A, G
2. B-57E
3. C-124
4. C-130B
5. C-133
6. C-141
7. DeHavilland CV-7A
8. F-4E
9. F-89
10. F-100
11. F-101
12. F-102
13. F-104
14. F-106
15. F-111D
16. FB-111
17. KC-135
18. L-19
19. L-20A
20. L-23
21. LC-26
22. Martin P5M-1
23. Martin XP-6M-1
24. Navy F-4D
25. Navy P2V-5F
26. Navy R5D-2Z
27. Navy SNB-5
28. OE-2
29. T-33
30. U-1

1. Bell AH-1G
2. Bell UH-1C
3. CH-1
4. H-13G
5. H-19
6. H-21B, C
7. H-23
8. H-25A
9. H-31
10. H-34
11. H-37
12. HO5-1
13. HOK-1
14. HRS-3
15. Hughes OH-6A
16. Kaman K-20
17. S-61L
18. S-62
19. V-107
20. XH-40
21. YCH-1B
22. Sikorsky YCH-54A

VERTICAL TAKEOFF AND LAND

1. Bell X-22
2. Lockheed XV-4A
3. LTV XC-142A
4. Ryan XV-5A

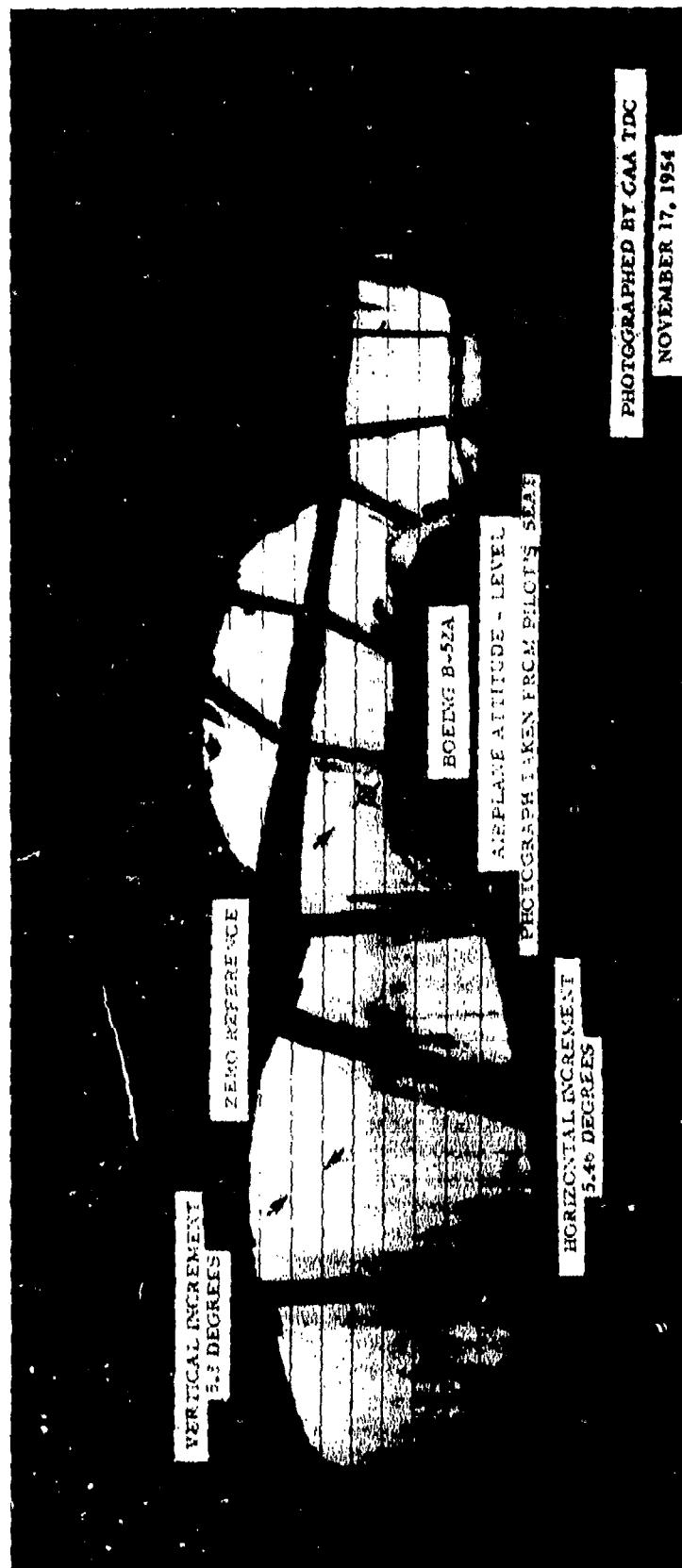


FIGURE 75. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE B-52A

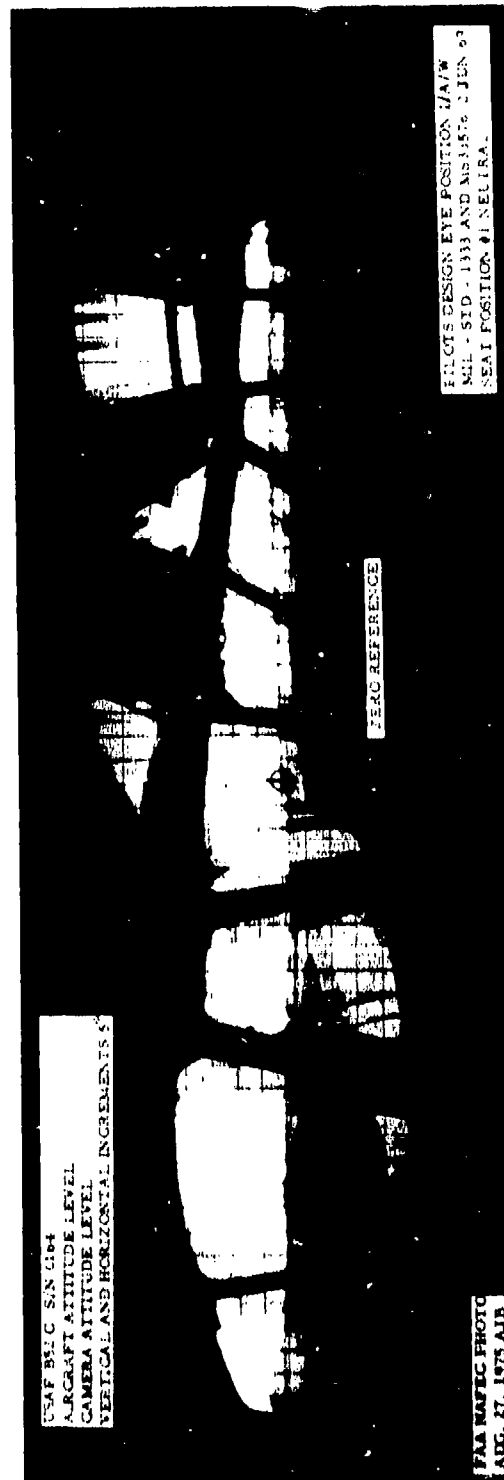


FIGURE 76. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE B-52G

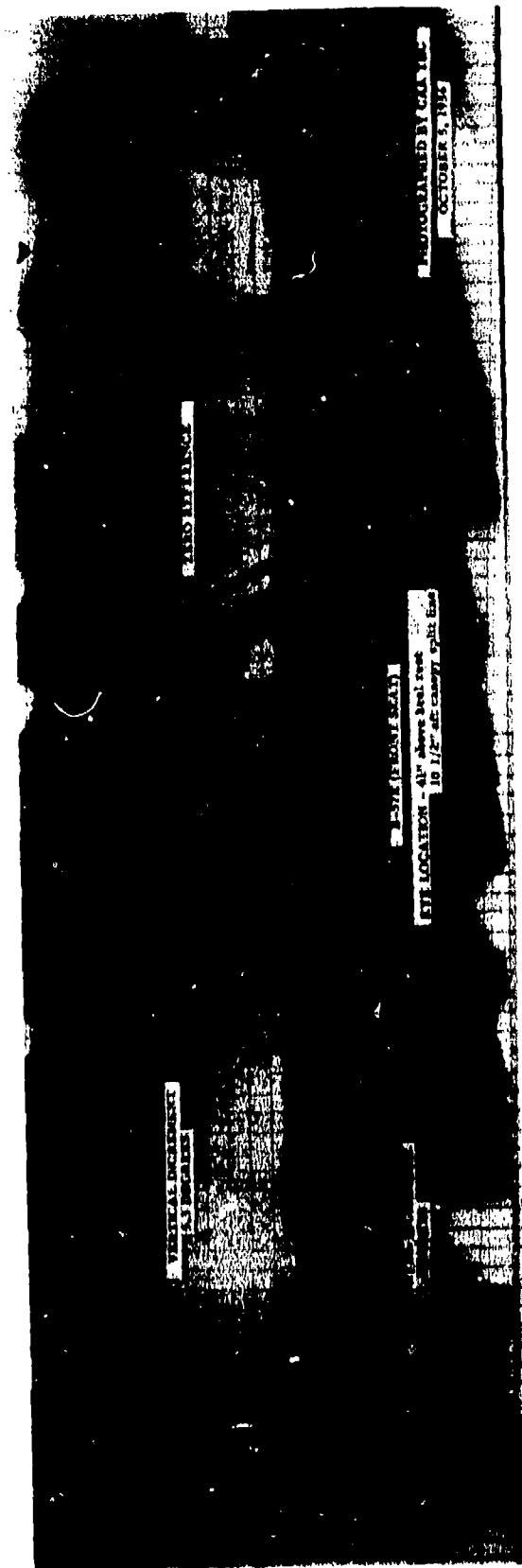


FIGURE 77. BINOULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE B-57E

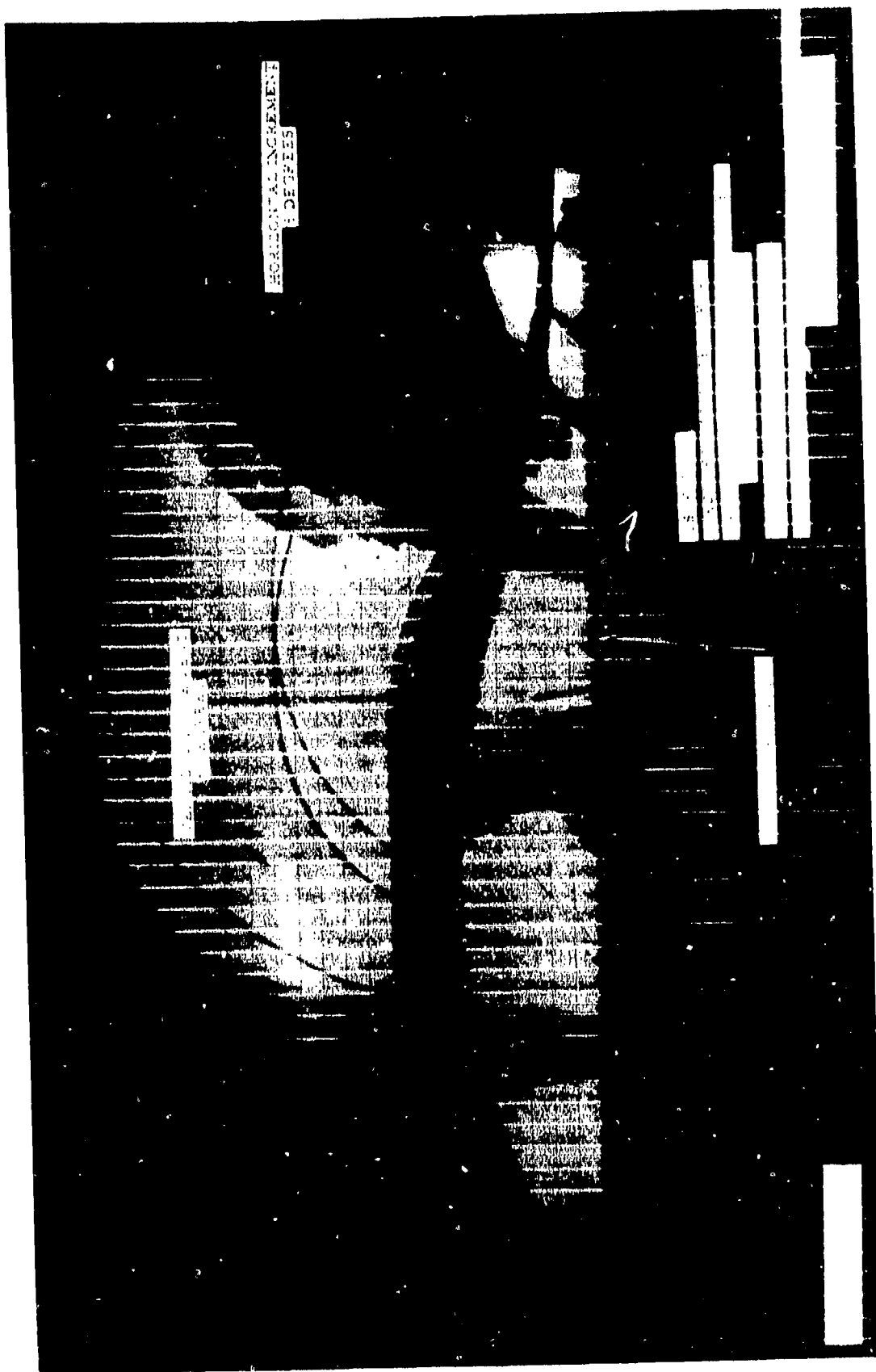
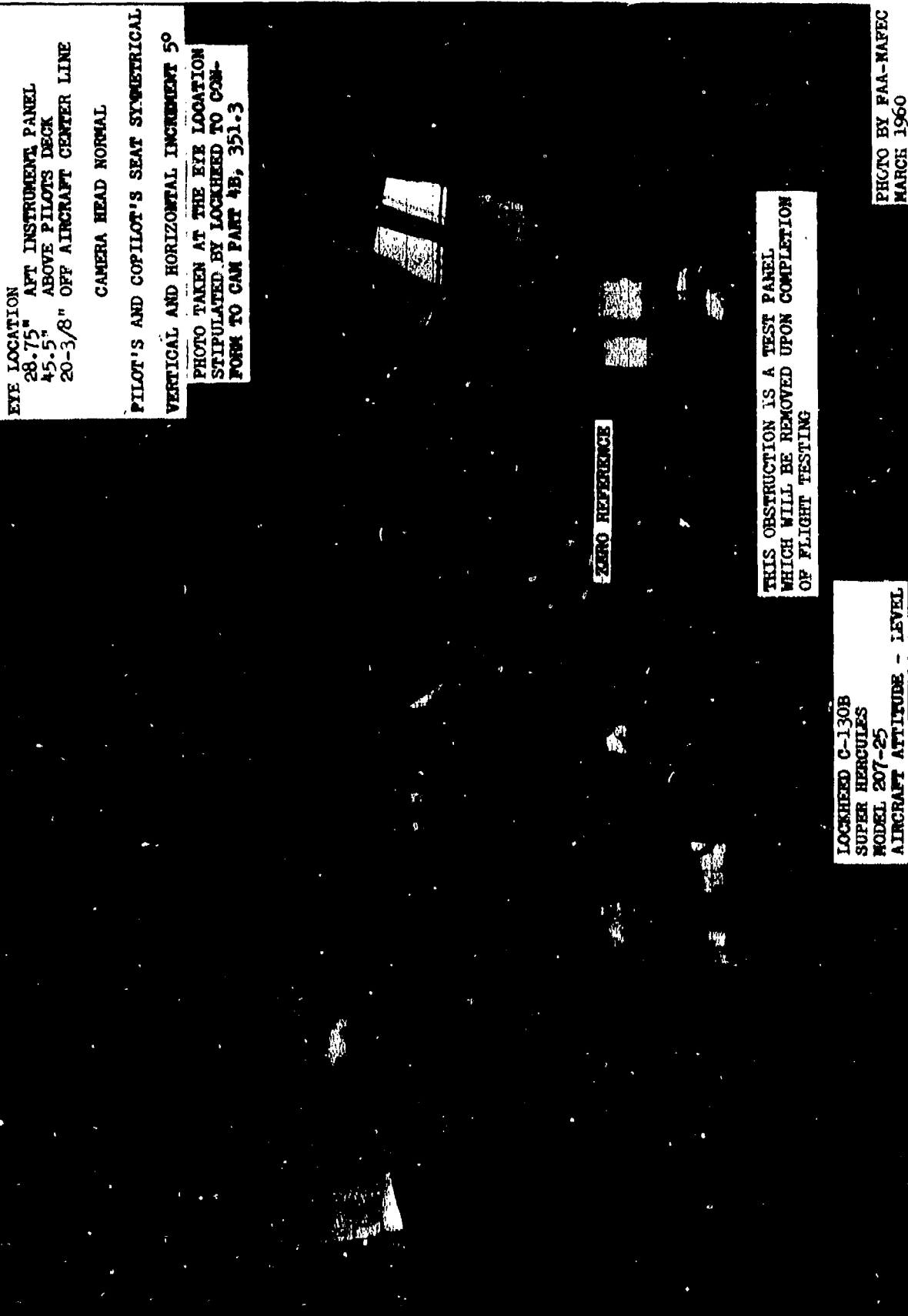


FIGURE 78. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE C-124



EYE LOCATION

28.75" AFT INSTRUMENT PANEL
45.5" ABOVE PILOTS DECK
20-3/8" OFF AIRCRAFT CENTER LINE

CAMERA HEAD NORMAL

PILOT'S AND COPILOT'S SEAT SYMMETRICAL
VERTICAL AND HORIZONTAL INCREMENT 5°

PHOTO TAKEN AT THE EYE LOCATION
STIPULATED BY LOCKHEED TO CON-
FORM TO CAN PART 4B, 351.3

ZERO REFERENCE

THIS OBSTRUCTION IS A TEST PANEL
WHICH WILL BE REMOVED UPON COMPLETION
OF FLIGHT TESTING

LOCKHEED C-130B
SUPER HERCULES
MODEL 207-25
AIRCRAFT ATTITUDE - LEVEL

PHOTO BY FAA-NAFEC
MARCH 1960

FIGURE 79. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT LOCKHEED C-130B



FIGURE 80. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE C-133



FIGURE 81. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE C-141

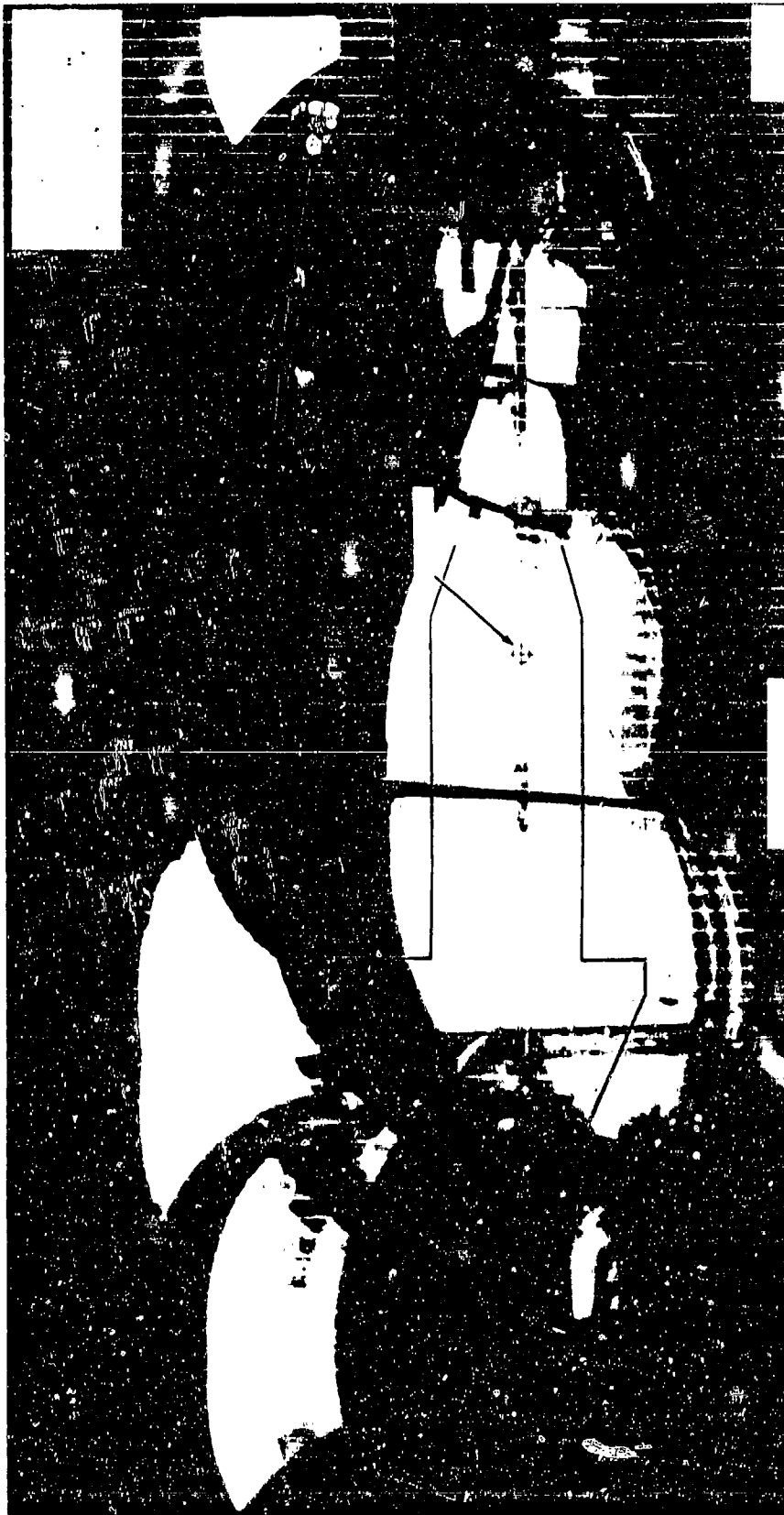


FIGURE 82. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DEHAVILLAND CV-7A

VERTICAL AND HORIZONTAL DISTANCE
NAUTIC PHOTOGRAPHY 14, 1974 A.E.



AB. PART BAMP LEVEL
CAMERA NORMAL AT PILOTS
EYE POSITION
94.4 IN. IS ABOVE FLOOR
24.0 IN. IS ALT OF INSTRUMENT
PANEL

FIGURE 83. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE F-4E



FIGURE 84. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE F-89

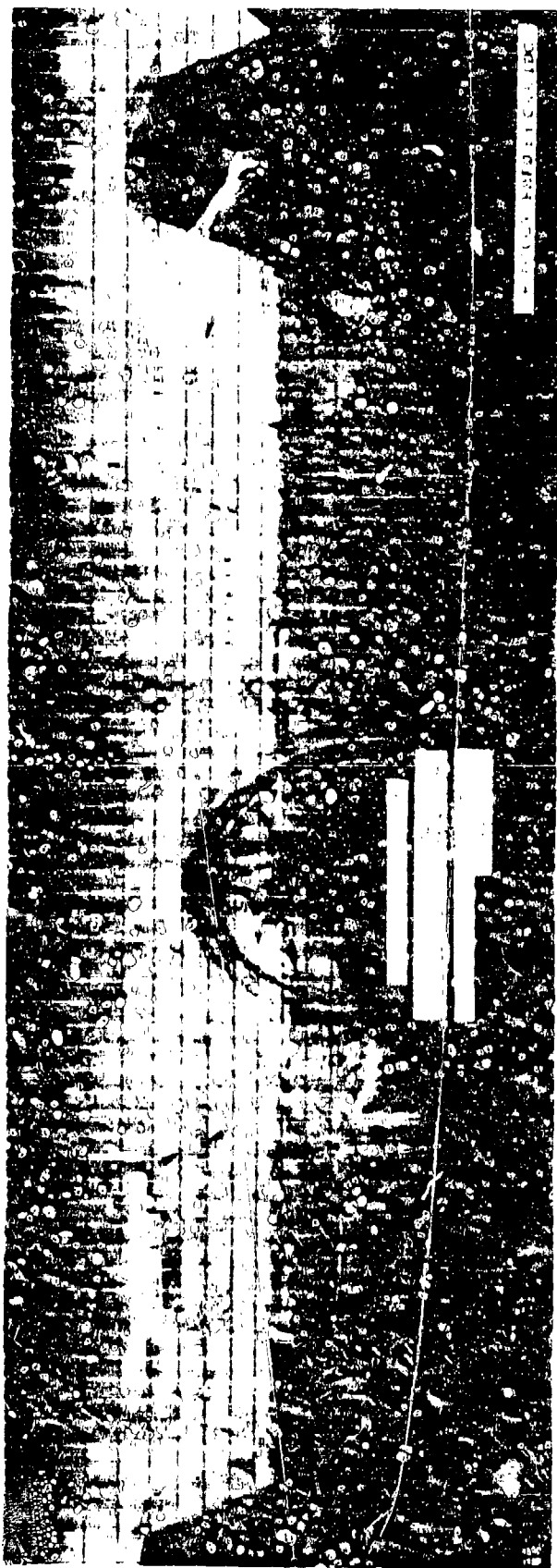


FIGURE 85. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE F-100A



FIGURE 86. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE F-101

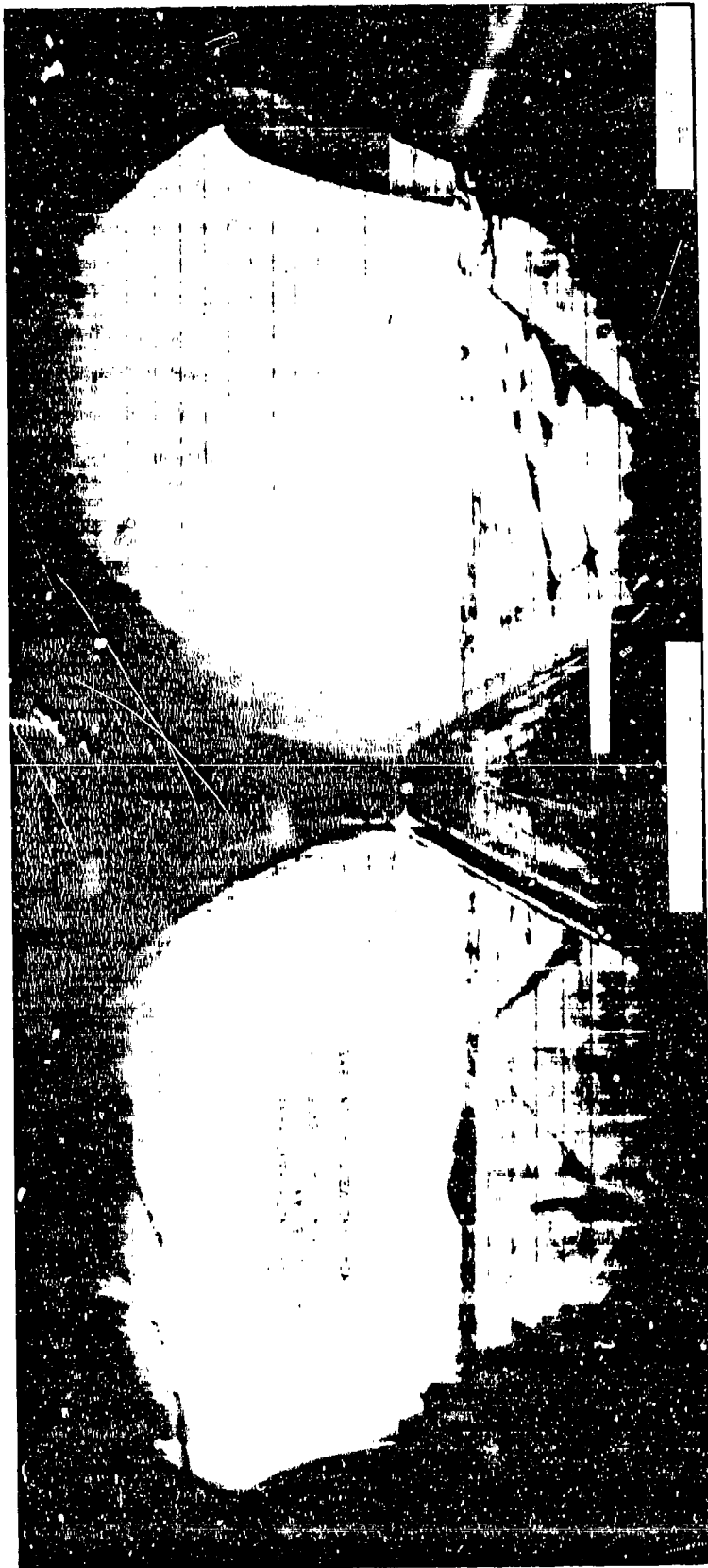


FIGURE 87. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE F-102A

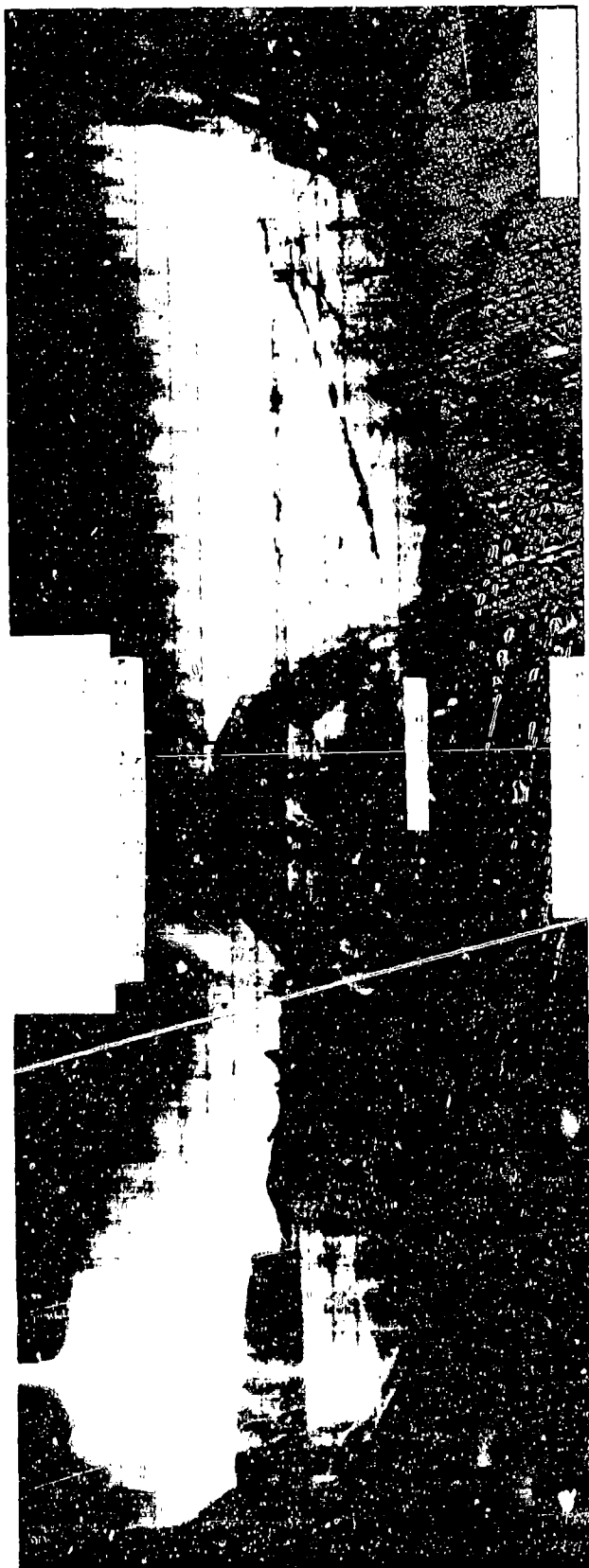


FIGURE 88. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE F-104A

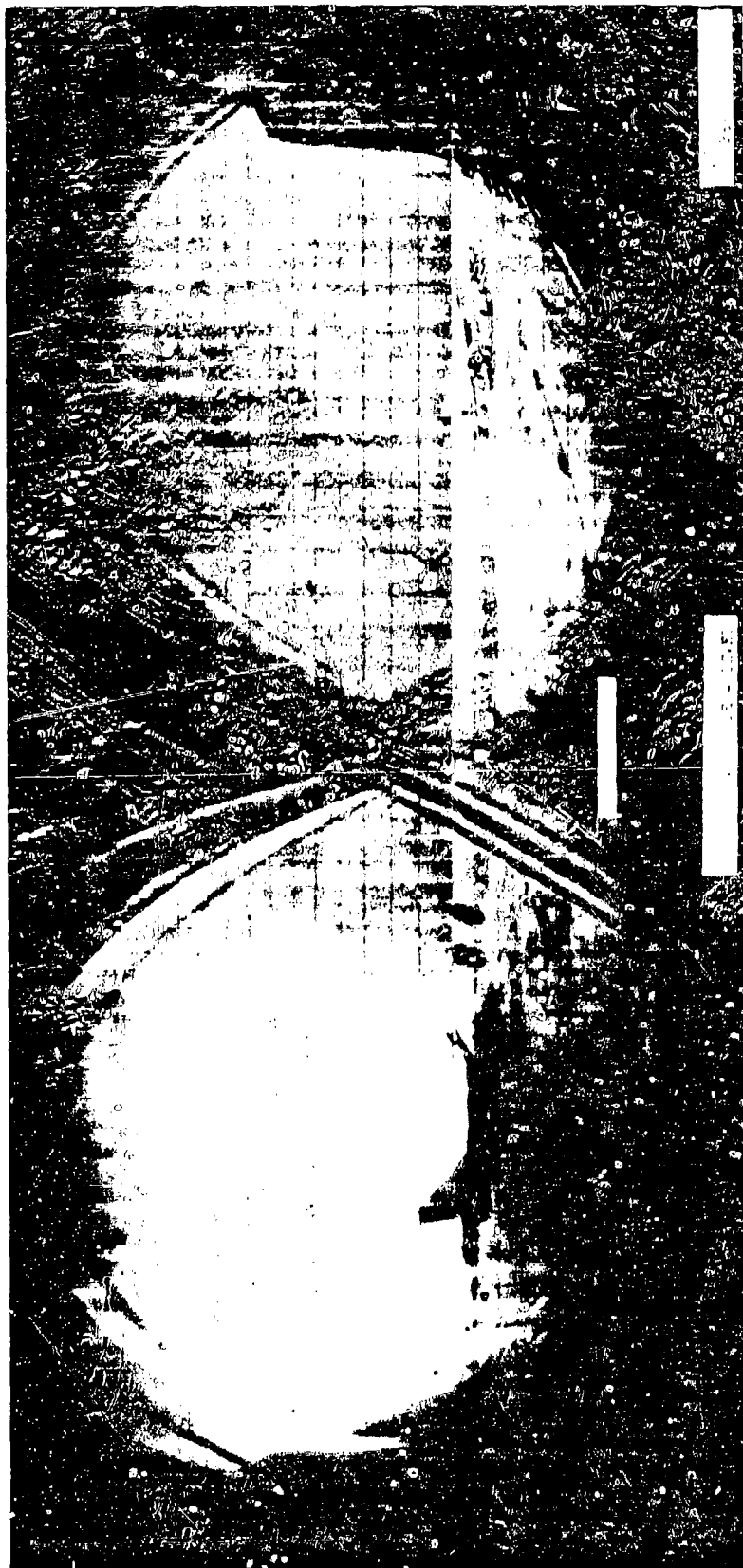


FIGURE 89. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE F-106A



FIGURE 90. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE F-111D



FIGURE 91. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT A1K FORGE F/3-111



FIGURE 92. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE KJ-135



FIGURE 93. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT ARMY L-19



FIGURE 94. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT ARMY L-20A



FIGURE 95. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT ARMY L-23



FIGURE 96. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT ARMY LC-126



FIGURE 97. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT MARTIN P5M-1

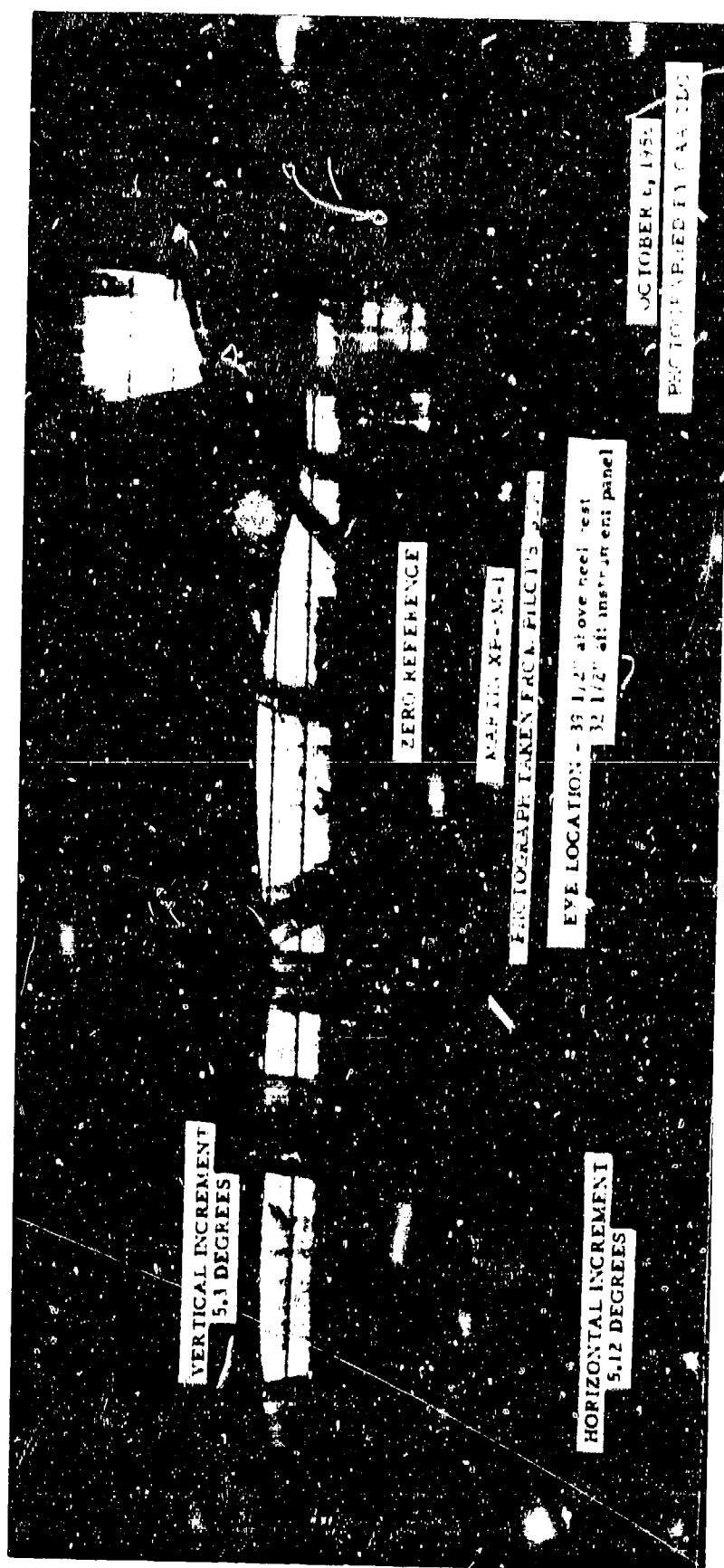


FIGURE 98. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT MARTIN XP-64-1



FIGURE 99. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT NAVY F-4D



FIGURE 100. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT NAVY P2V-5F



FIGURE 101. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT NAVY R5D-2Z



FIGURE 102. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT NAVY SNB-5

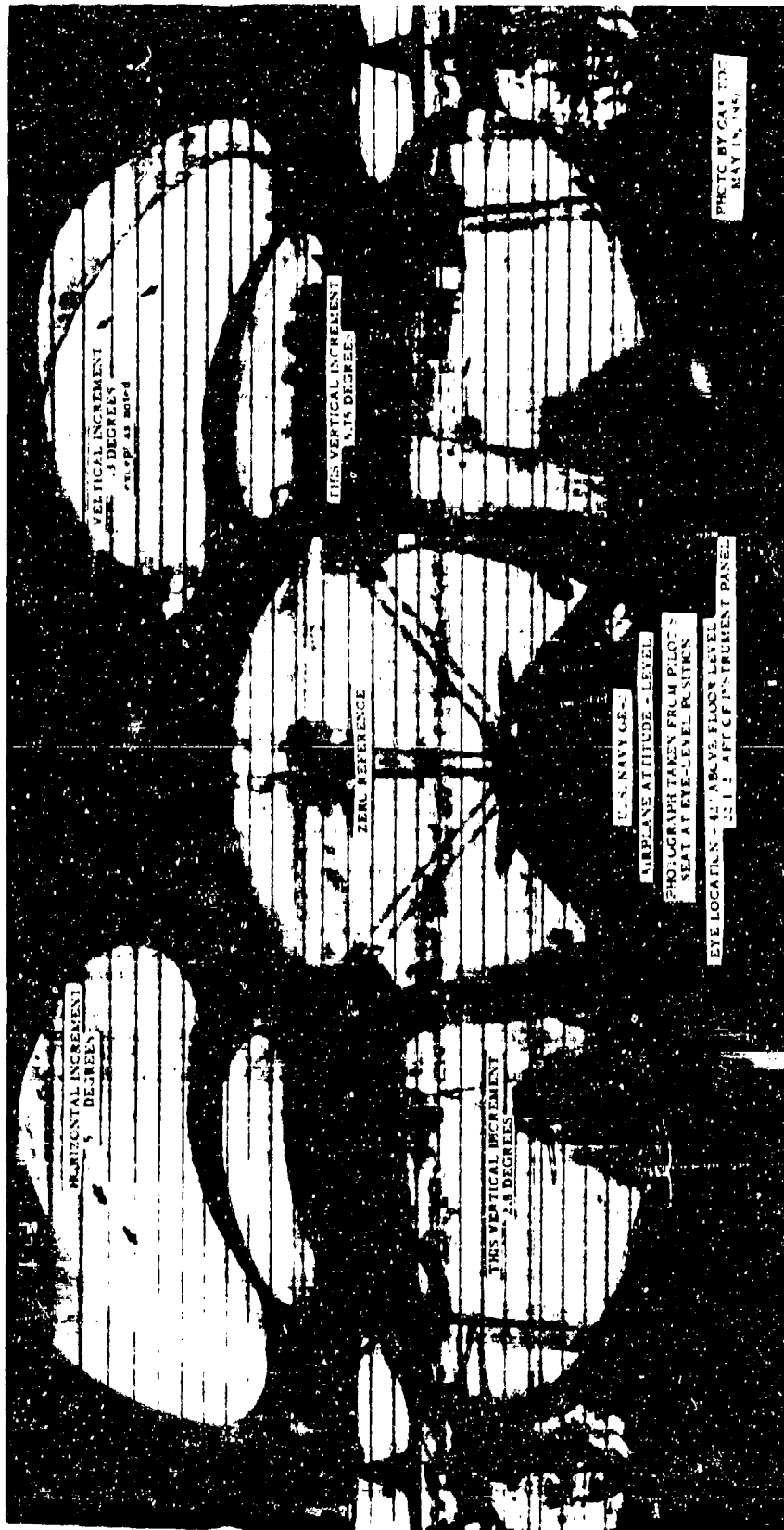


FIGURE 103. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT NAVY OE-2



FIGURE 104. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT AIR FORCE T-33



FIGURE 105. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT ARMY U-1

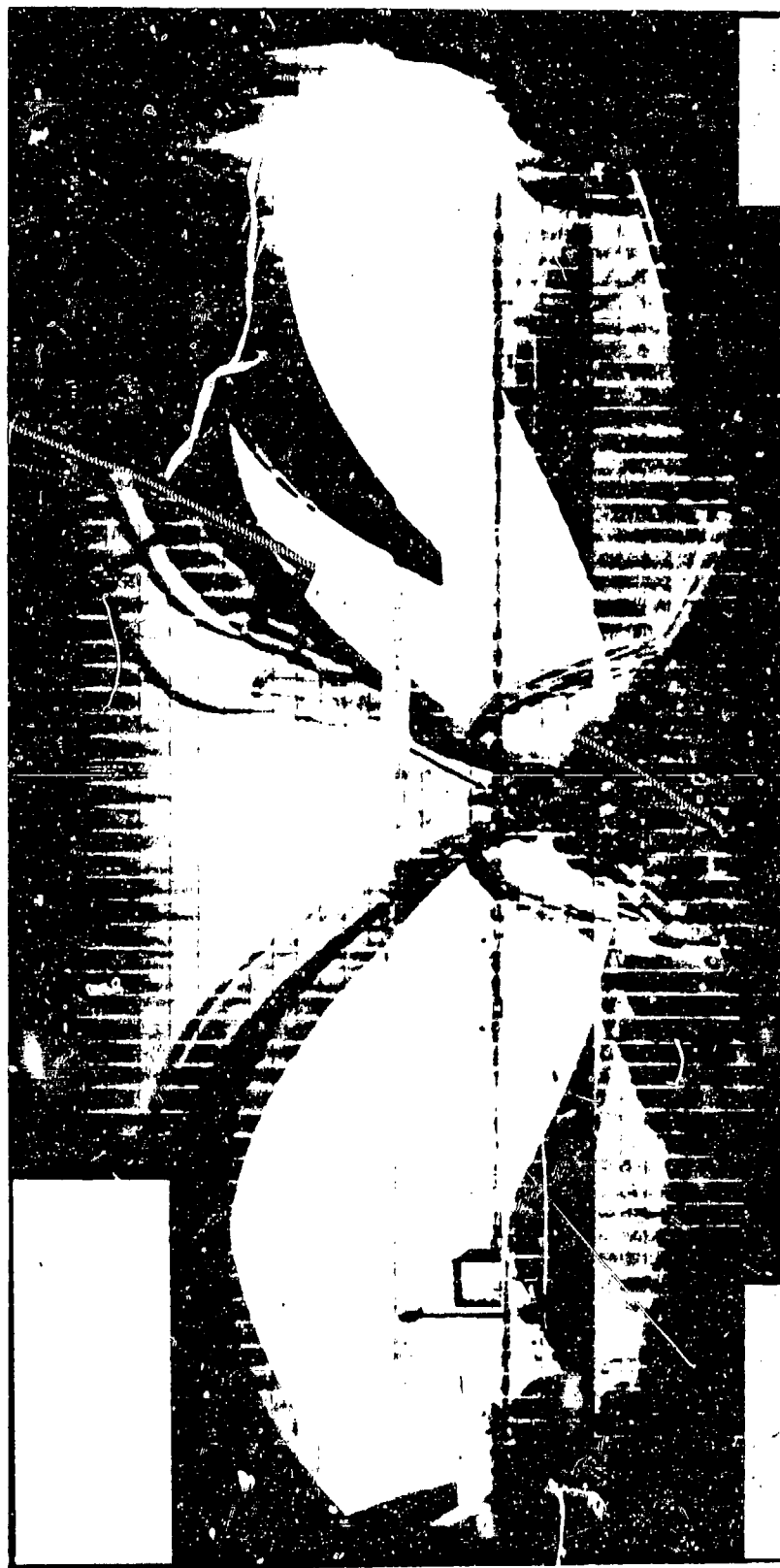
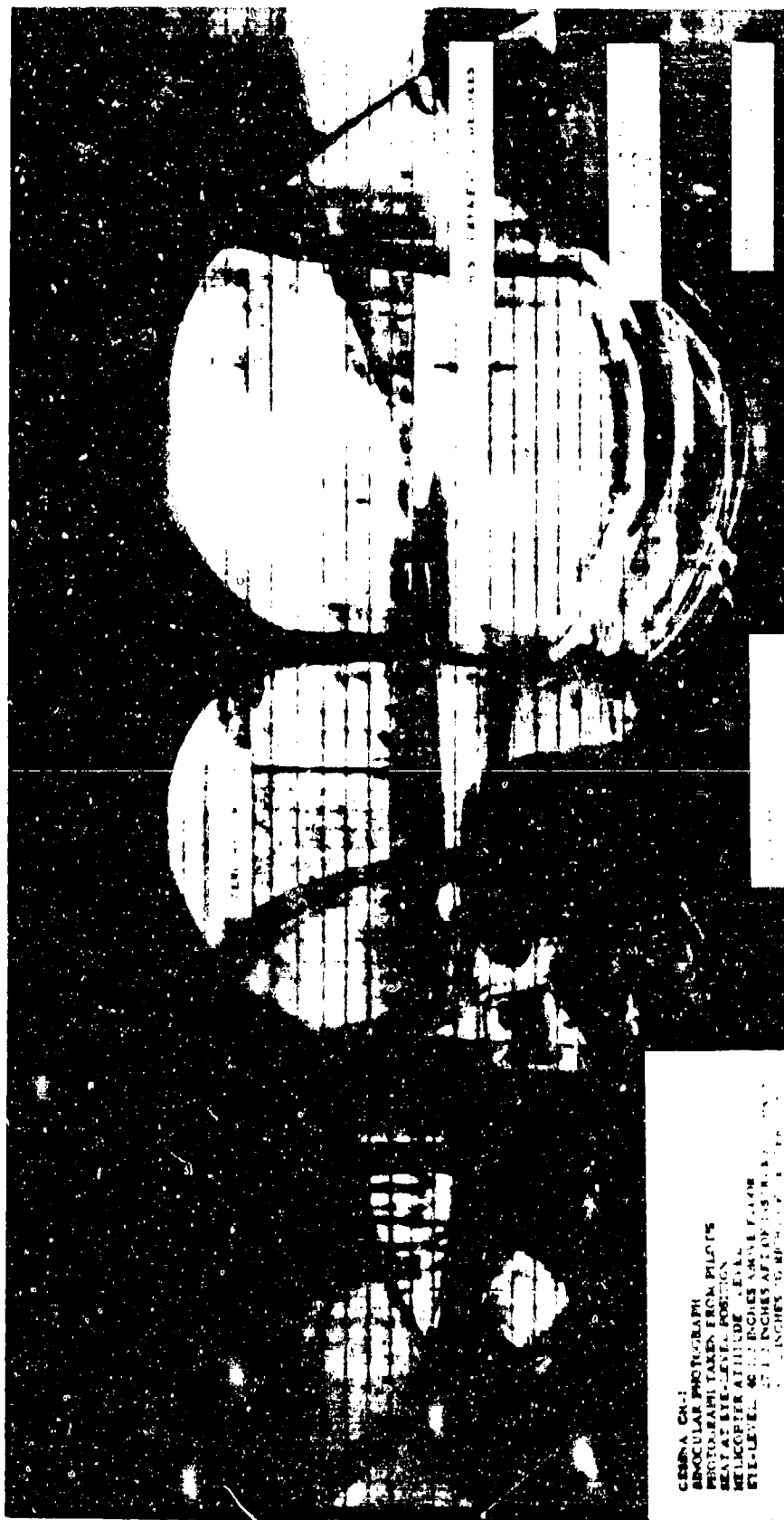


FIGURE 106. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BELL AH-1G



FIGURE 107. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BELL UH-1C



CESSNA CH-1
BINOCULAR PHOTOGRAPH
PHOTOGRAPH TAKEN FROM PILOT'S
SEAT AT EYE-LEVEL POSITION
HELICOPTER ALTITUDE - LEVEL
EYE-LEVEL - 27 INCHES ABOVE FLOOR
27 INCHES ABOVE FLOOR

FIGURE 108. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT CESSNA CH-1

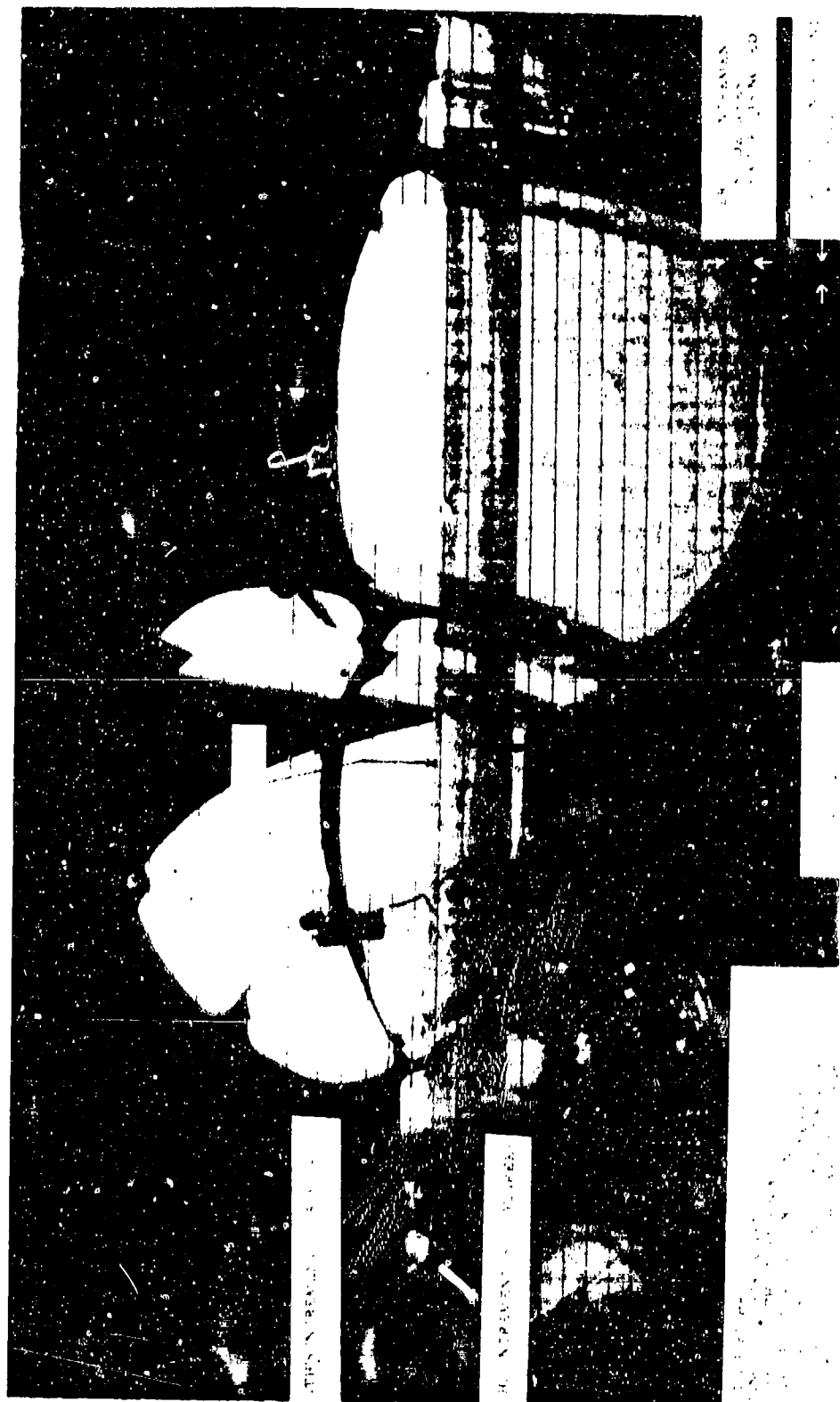


FIGURE 11J. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SIKORSKY H-19





FIGURE 112. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT HILLER H-23

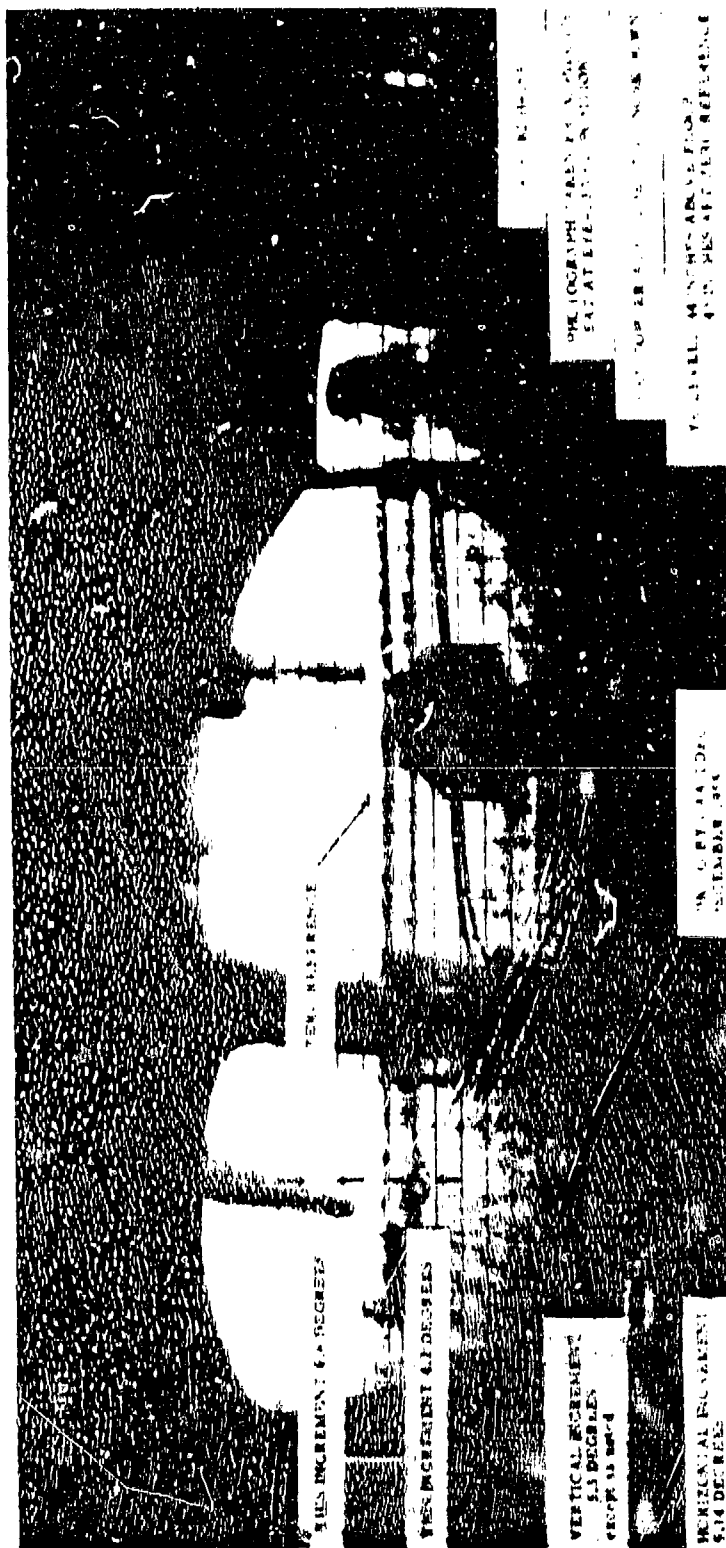


FIGURE 113. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT PIASECKI H-25A



FIGURE 114. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT DCMAN H-31



FIGURE 115. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SIKORSKY H-34



FIGURE 116. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SIKORSKY H-37



FIGURE 117. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SIKORSKY HO5-1



FIGURE 118. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT KAMAN HOK-1

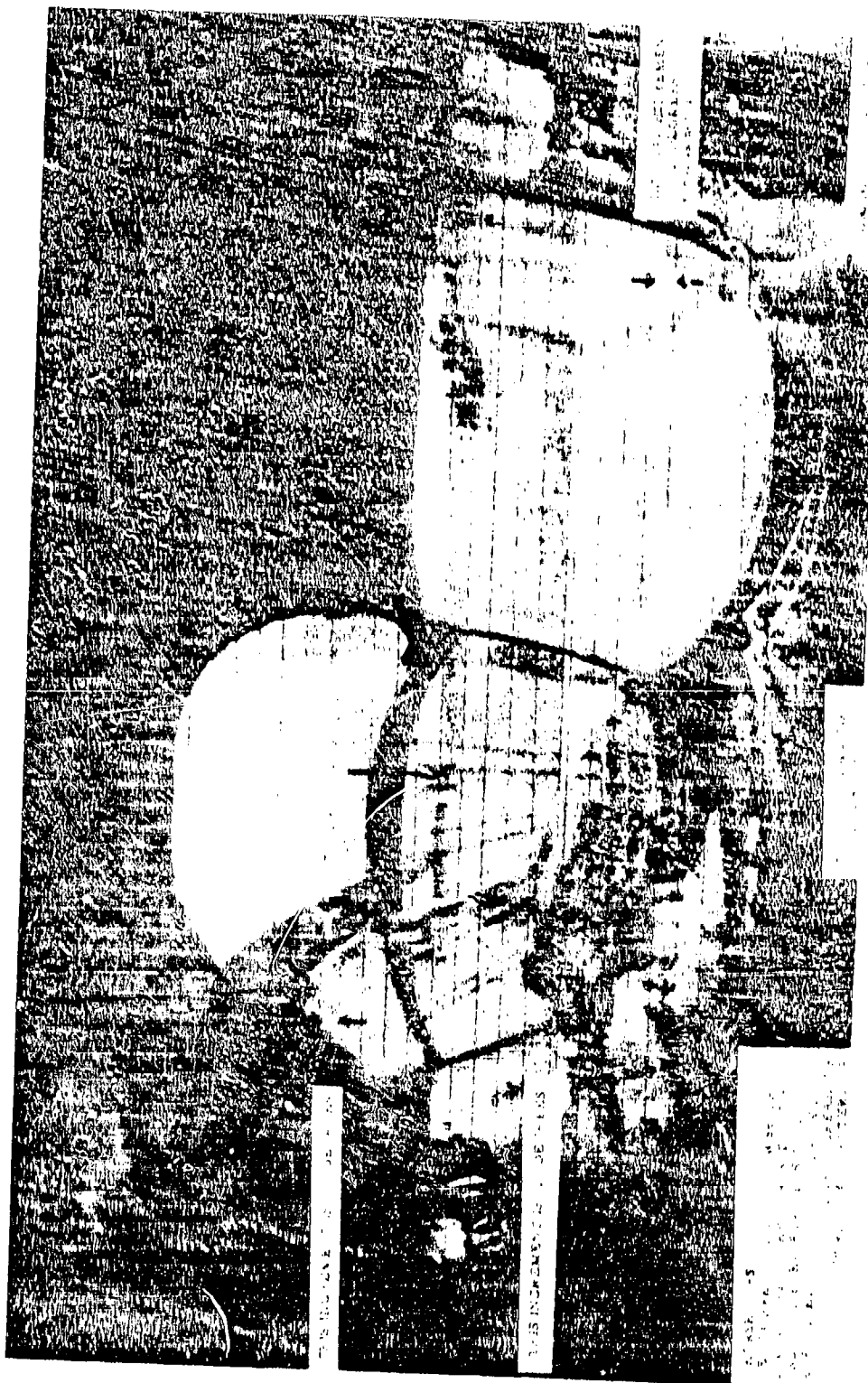


FIGURE 119. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SIKORSKY HRS-3

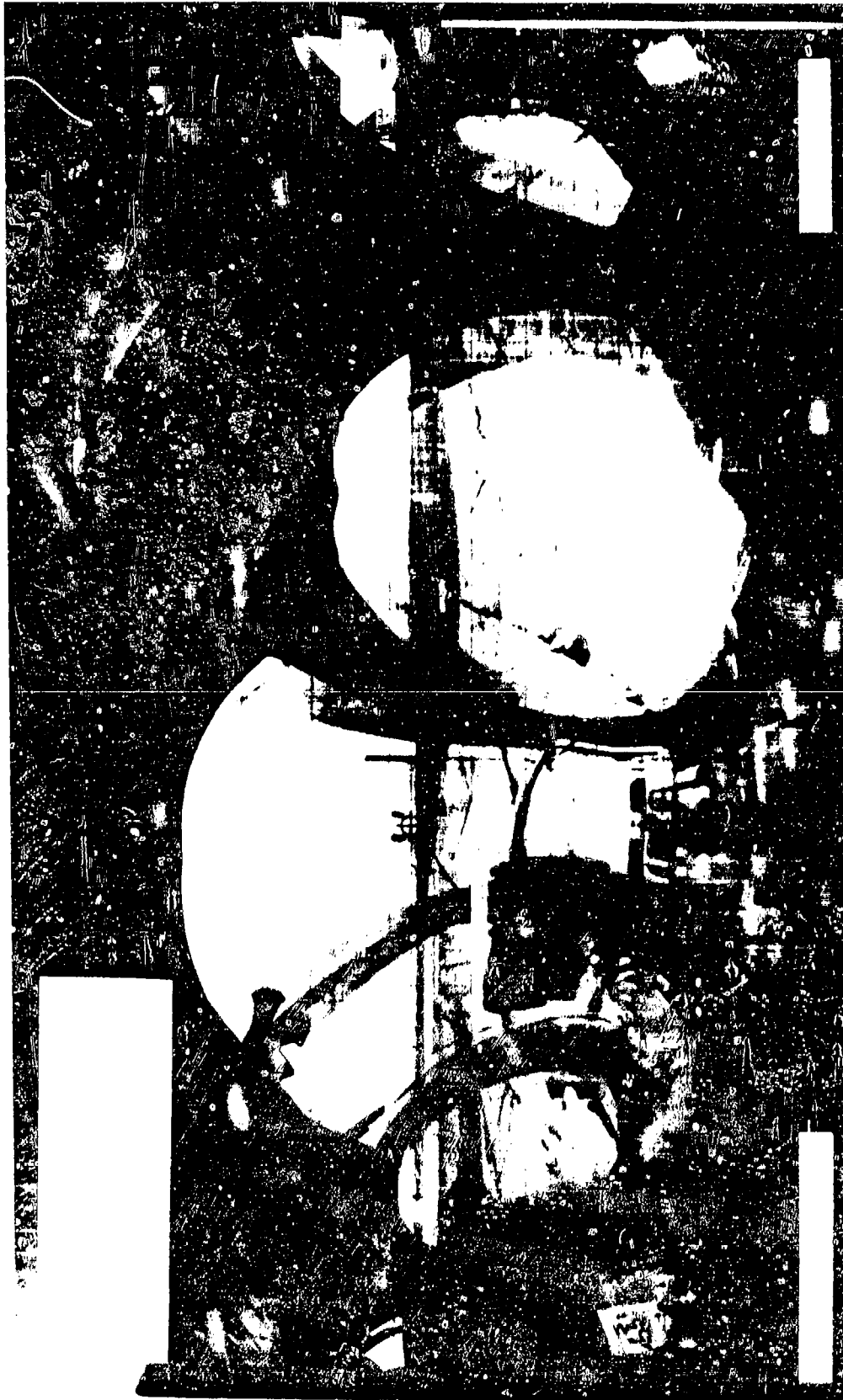


FIGURE 120. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT HUGHES OH-6A



FIGURE 121. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT KAMAN K-20

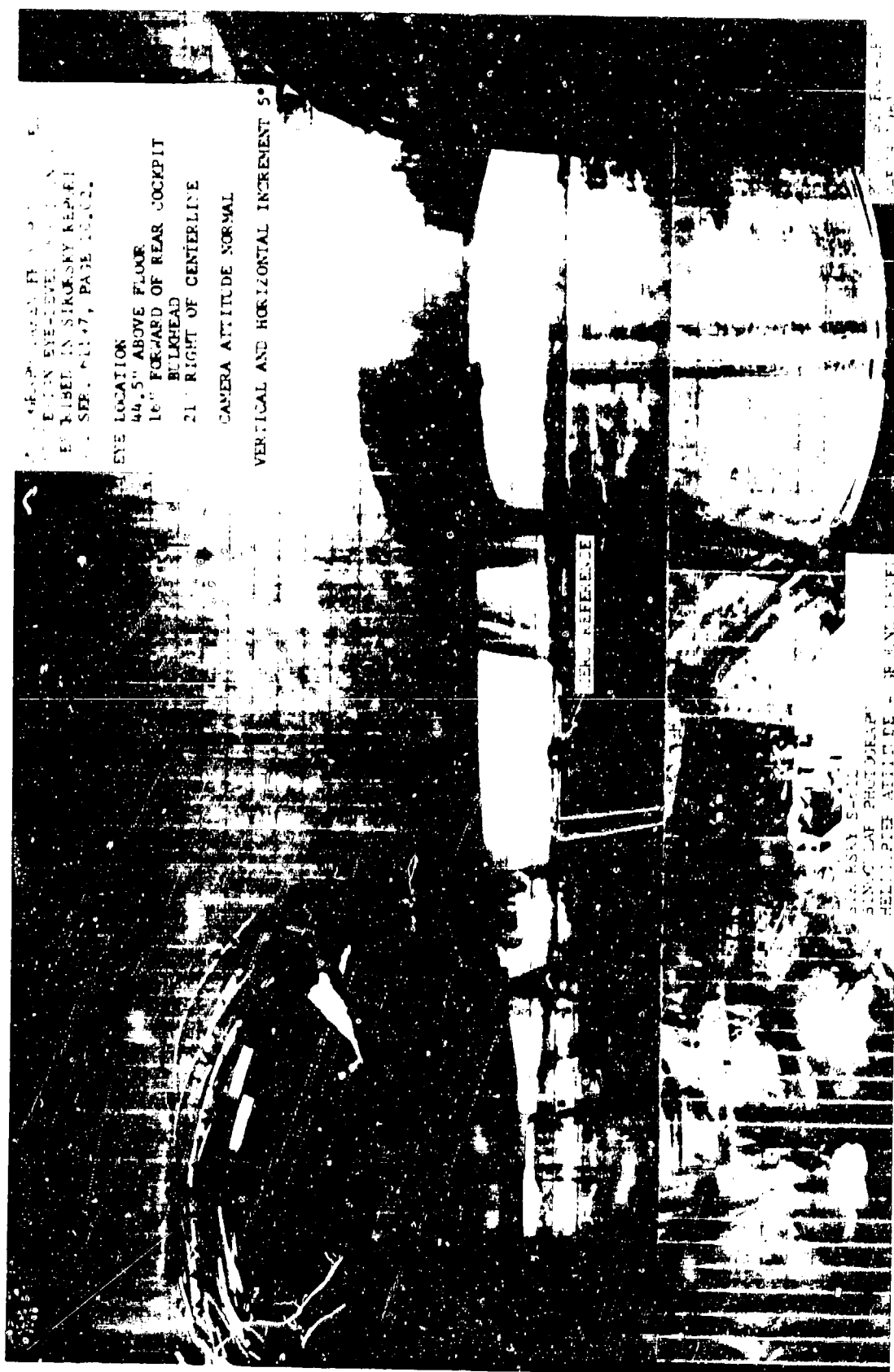


FIGURE 122. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SIKORSKY S-61L



FIGURE 123. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SIKORSKY S-62



FIGURE 124. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT VERTOL 107



FIGURE 125. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BELL XH-40

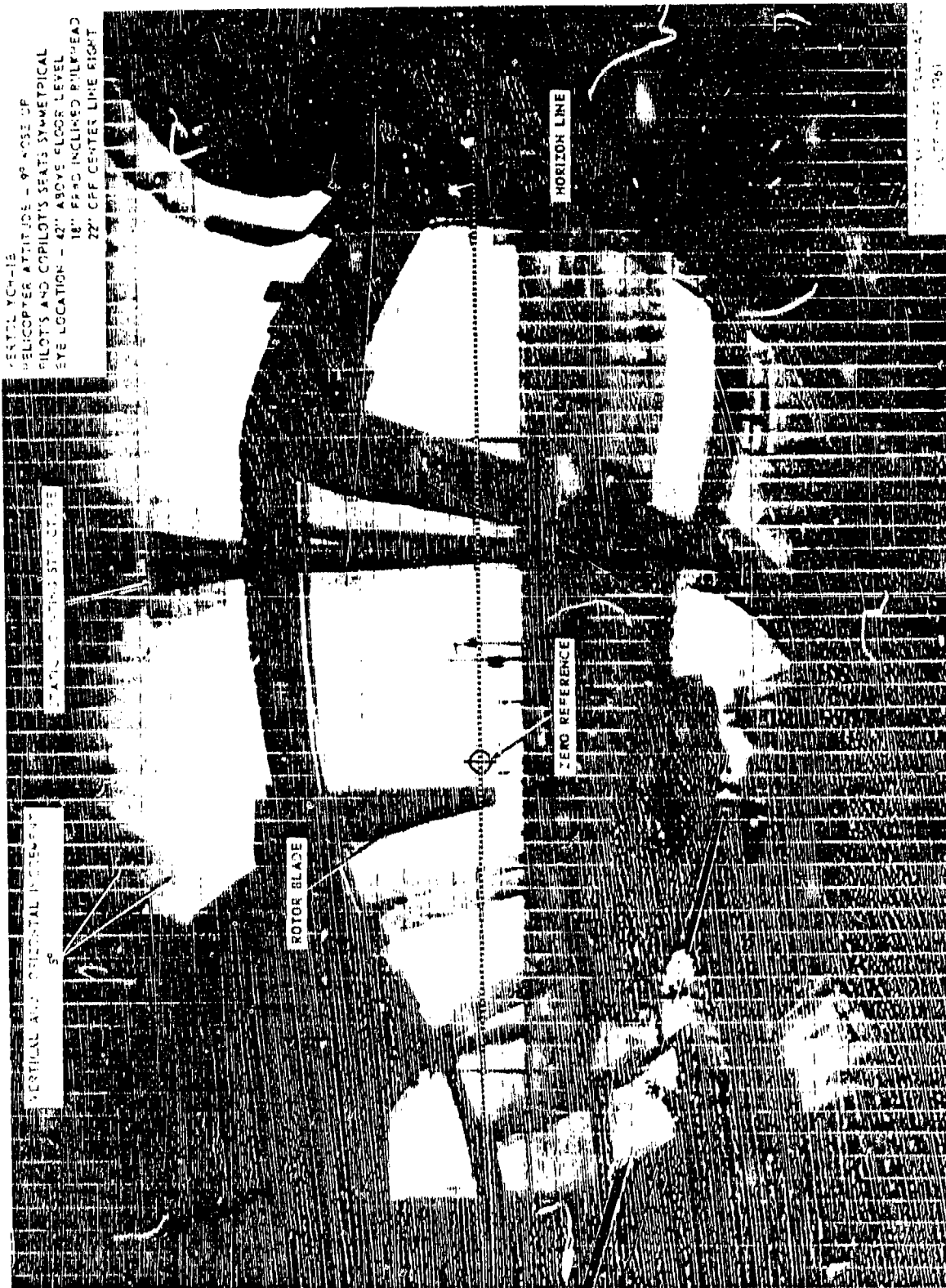


FIGURE 126. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT VERTOL YCH-1B



FIGURE 127. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT SIKORSKY YCH-54A



FIGURE 128. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT BELL X-22

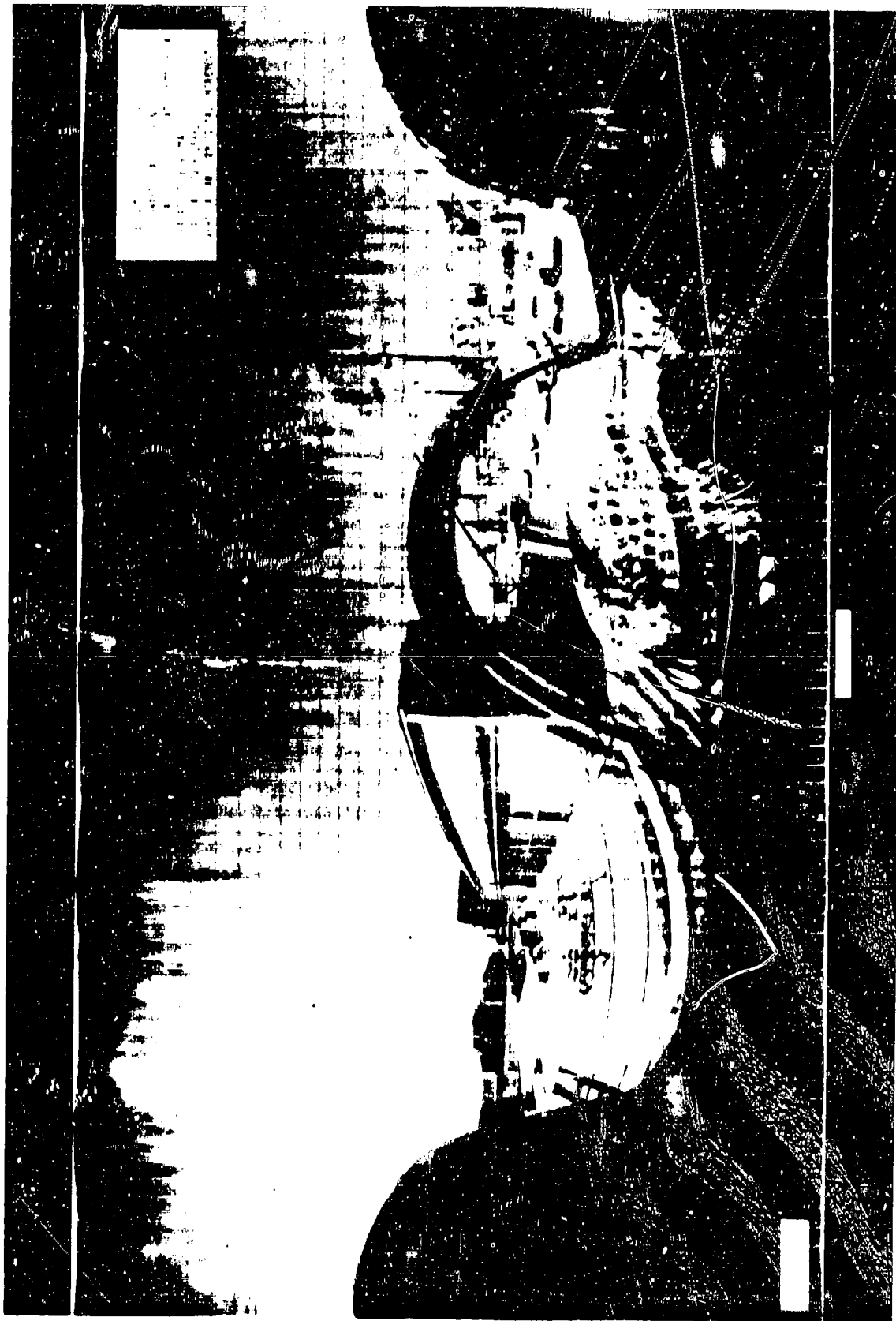


FIGURE 129. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT LOCKHEED XV-4A

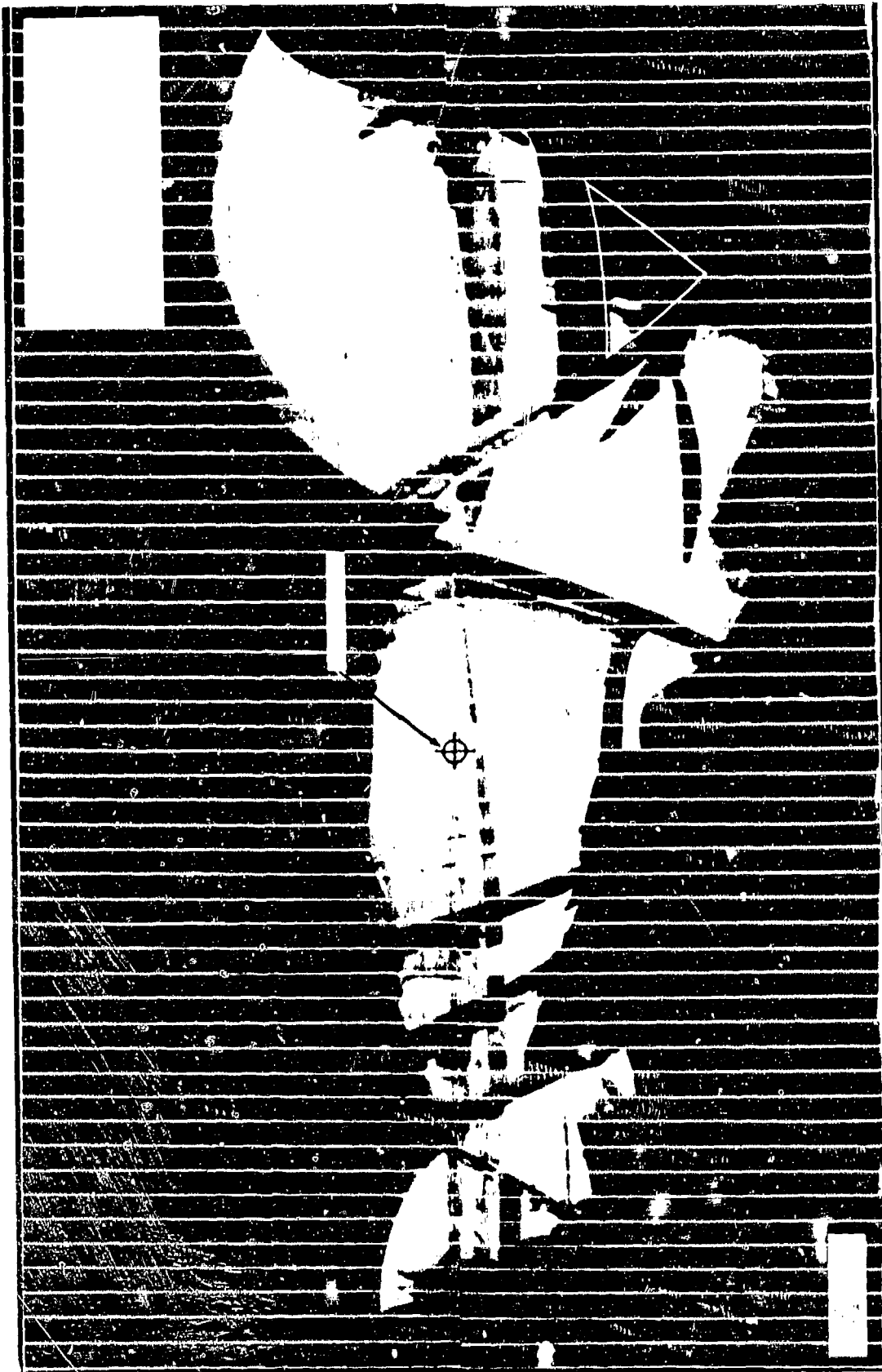


FIGURE 130. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT LTV XC-142A



FIGURE 131. BINOCULAR COCKPIT VISIBILITY PHOTOGRAPH OF AIRCRAFT RYAN XV-5A